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REPORTS

TO THE

LOCAL GOVERNMENT BOARD

ON

PUBLIC HEALTH AND MEDICAL MATTERS.

(NEW SERIES No. 1.)

Dr. Eastwood's Report to the Local Government Board on American Methods for the Control and Improvement of the Milk Supply.



LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, LTD., 34-40, BACON STREET, E.

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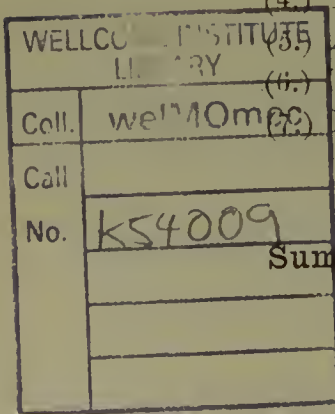
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TO the RIGHT HON. JOHN BURNS, M.P.

President of the Local Government Board.

SIR,

THE International Congress on Tuberculosis held at Washington in September last gave opportunity for obtaining much information respecting the different aspects of the administrative control of this disease : and as Dr. Eastwood, one of the expert pathologists in the employment of the Royal Commission on Tuberculosis, was attending the Congress, you gave instructions that he should be commissioned to examine into and report upon the methods adopted in various American States for the control of tuberculosis among herds of cattle in the United States and the prevention of the communication of bovine tuberculosis to man.

Such an investigation fitted in well with a further inquiry into the means for securing clean milk which have been adopted in some American States, and Dr. Eastwood accordingly was asked to report also on this aspect of the milk question.

The information collected by him, and his personal comments thereon are interesting and instructive ; they will be of value not only in relation to prospective legislation but also as throwing light on administrative problems in this country.

I am, Sir,

Your obedient Servant,

ARTHUR NEWSHOLME.

Mar. 25th, 1909.

Dr. Eastwood's Report to the Local Government Board on American Methods for the Control and Improvement of the Milk Supply.

The information contained in this report was obtained by me in the United States during the months of September and October, 1908. The States to which I devoted particular attention are :—Minnesota, Wisconsin, Illinois, Maryland, Pennsylvania, New York, and Massachusetts ; I also spent some time in the District of Columbia.

My work has been carried on in accordance with the instructions of the Medical Officer of the Board, who desired me to study, from the standpoint of practical administration, American methods directed to the control and improvement of the milk supply.

PART I.

The conditions of the Milch Cows, with Special Reference to the Detection of Tuberculosis and the Policy of Compensa- tion.

THE METHODS OF VARIOUS STATES. WISCONSIN.

My information concerning the health of the dairy cattle in this State was obtained at Madison from the Agricultural Experiment Station of the University of Wisconsin. Most of my facts were derived from Mr. C. Hoffmann, who is devoting special attention to this subject under the direction of Dr. H. L. Russell.

The application of the tuberculin test has shown that tuberculosis is common throughout the State and is particularly prevalent in the older and more densely populated districts. The Northern two-thirds of the State are of comparatively recent development and are thinly populated. In this area the total number of animals tuberculin tested during a period of three years (1905-8) amounted to 23,351. Out of this number positive reactions were obtained in 781 cases, or 3.5 per cent. The cattle tested constituted 1,586 distinct herds, amongst which 281, or 17.7 per cent., contained infected animals. In the Southern third of the State, which has been settled for a longer period and is more densely populated, 43,176 animals were tested during the same period and gave reactions in 4,570 cases, or 10.5 per cent. The animals formed 2,164 herds, of which 941, or 43.4 per cent., showed infection.

On my inquiring whether there was any evidence that the amount of bovine tuberculosis was diminishing in the State of Wisconsin, Mr. Hoffmann produced the following data. During a period of 12 months (1905-6) 9,718 animals were tested, and of these 1,726, or 17.7 per cent., reacted. The animals comprised 486 herds, the number of herds found infected being 257, or 52.8 per cent. During the next 12 months (1906-7) 15,816 animals were tested; 1,291, or 8.1 per cent. reacted. These animals constituted 868 herds, amongst which 314, or 36.1 per cent., were found infected. During the next period of 12 months (1907-8) 40,993 animals were tested and 2,334, or 5.6 per cent., reacted. The animals formed 2,396 herds, of which 651, or 26.9 per cent., were found infected. All the above figures refer to separate tests on different animals. These data show that the use of the tuberculin test is increasing; they also afford some ground for believing that the amount of tuberculosis is on the decline.

Much work remains to be done before the condition of all the cattle throughout the State will be ascertained. I was unable to obtain complete statistics of the proportion of tested and untested cattle in the whole State but was shown the data which had been obtained from a very large number of counties. The percentage of tested animals varied very considerably. In some counties it was 5 per cent. or less; the highest figure I noticed was 57.4 per cent.; the majority of the figures were distributed irregularly in intermediate positions between 5 and 50. The Northern two-thirds of the State seem to be more enterprising in this respect than the Southern third. In the former area the number of animals tested during the last year was nearly seven times as great as the number tested the year previously, whereas in the South the number of tests was less than double that of the previous year.

The facts quoted above indicate that in the State of Wisconsin the efforts to eradicate bovine tuberculosis are making some progress. To what causes is this encouraging position attributable? As Mr. Hoffmann's share of the work brings him into direct and intimate contact with the farmers, his experience has the value of first hand information. He attributes the success of their work to the following causes:—

1. First and foremost, the post mortem demonstrations to farmers. These are arranged at county fairs in various parts of the State, in the Agricultural College, and wherever opportunity arises. They are prefaced by a popular lecture explaining the financial loss arising from tuberculous cattle, the insidious nature of the disease, and the economic advantages of detecting and eradicating it at an early stage. The farmers are invited to inspect a batch of animals which have reacted to the tuberculin test, and special attention is called to those beasts which from their external appearance would be regarded as perfectly healthy. The animals are then slaughtered and the extent and nature of the disease is demonstrated to the farmers. In this way the practical value of the tuberculin test is proved far more convincingly than by verbal arguments and theories.

2. The publication, at frequent intervals, of practical advice to farmers in the bulletins of the Agricultural Experiment Station, which is in cooperation with the Wisconsin Live Stock Sanitary Board.

3. The free distribution of tuberculin, on condition that the farmer obtaining it furnishes a complete record of the test.

4. All students at the Agricultural College are taught how to employ the test. Special short courses are arranged for farmers at convenient seasons of the year. The number of students receiving this instruction now amounts to 1,000 per annum.

5. The farmer is offered the choice of three methods for the disposal of infected animals.

- (a.) The cattle if in good physical condition, may be sent under the auspices of the State Live Stock Sanitary Board to some centre for slaughter where they can be examined by inspectors of the Federal Government. The owner receives the full net value of the animals which pass the inspection.
- (b.) The cattle may be appraised by three appraisers appointed by the local justice of the peace. The maximum appraisal must not exceed fifty dollars. The owner is entitled to two-thirds of the appraised valuation, but before he receives payment the local health officer must certify that the barns and premises in which the reacting stock were kept have been efficiently disinfected. The State authorities have the cattle slaughtered under Federal inspection and retain the proceeds from their sale.
- (c.) If the affected cattle are valuable pure bred animals, the owner may hold them in quarantine, under the rules of the State Live Stock Sanitary Board, and is allowed to adopt the Bang System. This system requires (1) permanent separation of reacting from non-reacting animals, (2) separation, immediately after birth, of all calves born of reacting animals, and (3) feeding of all calves with milk, which, if obtained from reacting animals, has been heated at a temperature sufficient to kill any tubercle bacilli which may be present.

6. The farmers who have adopted the test approve of it and recommend it to their friends.

7. Farmers are advised not to replenish their herd except from tested animals.

8. Fourteen cities have adopted a regulation requiring that cows supplying milk shall be tuberculin tested. These regulations affect 25 per cent. of the people in the State. (Population of Wisconsin in 1900=2,069,042; population of the cities requiring the test=523,302.)

The official body in which the control of bovine tuberculosis is vested in the State of Wisconsin is the Live Stock Sanitary Board. This Board consists of three members of the State Board of Agriculture, together with the bacteriologist of the State Agricultural College and the State Veterinarian. The duty of the Board is "To protect the health of domestic animals of the State, and to determine and employ the most efficient and practical means for the prevention, suppression, control, and eradication of dangerous, contagious, or infectious diseases among domestic animals." It is unnecessary to give a detailed account of the enactments governing the action of this Board, but it may be noted that it is part of their duty to see that cattle are not imported into the State for breeding or dairy purposes unless they have successfully passed the tuberculin test.

An important feature of the Wisconsin system is the active

co-operation of an educational body, the Agricultural College, with a sanitary authority, the Live Stock Sanitary Board. In addition to disseminating scientific and practical instruction amongst the farmers, the experiment station of the Agricultural branch of the University assumes the responsibility of supervising a large amount of the tuberculin testing. The annual returns of the tuberculin tests officially recognised by the State are made under two heads—(1) tests made by the State Veterinarian, and (2) tests made by the Agricultural Experiment station. The figures which I have quoted above represent the combined totals of (1) and (2).

It is the policy of the Agricultural Experiment Station to encourage the farmers to do the actual work of testing themselves. When a farmer applies to the Experiment Station for tuberculin he is required to fill up a form stating the details of his requirements and undertaking—(1) to make the test within 30 days after the receipt of the tuberculin and to furnish the station with a full report of the test on the form provided for that purpose; (2) in case any tuberculous animals are found in his herd, to remove them at once from the healthy portion of the herd; and (3) in case any tuberculous animals are found, thoroughly to disinfect the stables occupied by the herd. This undertaking has to be signed by the owner of the herd and by the person making the test. The Experiment Station examines the report of the temperature records and then informs the owner of the result of the test, the duty of the person actually making the test being merely to record observations, not to interpret them. Of the tests supervised in this way by the Experiment Station during the year 1907–8, 25,719 were performed by the farmers themselves, and 3,099 by veterinarians. The farmers' tests seem to have been carefully recorded, the number which it was found necessary to discard being only 77; the work of the veterinarians, I was informed, exhibited a higher proportion of error. The tuberculin which the Experiment Station supplies to applicants is obtained free of charge from the Bureau of Animal Industry at Washington.

The facts which I have quoted certainly indicate that some progress is being made in Wisconsin towards the eradication of bovine tuberculosis. Will this progress be maintained? Perhaps an answer to this question may be given with more confidence in the course of the next few years, when further evidence will have accumulated with regard to the following points:—(1) The proof that after repeated testing the herds now certified to be clean remain clean; (2) the increase in the number of such herds; (3) the success of the farmers who are now trying to eradicate the disease by the Bang method or by vaccination; (4) the extent to which farmers continue to resort to the alternative method of slaughter for the disposal of their tuberculous stock; (5) the continued willingness of the State to meet demands for compensation which are made upon it; (6) the evidence of an actual preference on the part of the public for dairy produce from herds which are free from tuberculosis.

What appears to me the most encouraging feature of the system now on its trial in Wisconsin is that it is mainly based on an appeal to the business instincts of the farmer. A large number of the farmers are enterprising, prosperous, making money rapidly, and correspondingly anxious to make more. This is the type of person who is capable of looking to the future, and of appreciating the financial advantages of eliminating tuberculosis, without being deterred by the temporary disadvantages arising from the length of time and difficulty involved in the attainment of this object. He anticipates a better return from his cattle, a better reputation and a higher price for his dairy products, and an increased value for land in districts known to be free from bovine tuberculosis. He would resent, and do his best to evade, any attempts at coercion, and his desire to safeguard the interests of human health may not be more than commensurate with the demand on the part of his customers for food products free from pathogenic germs; but when he finds that rivals are trying to make more money by getting rid of bovine tuberculosis, his best energies are stimulated, and he is determined not to be left behind in the competition.

A feature of the Wisconsin system which has excited much interest and not a little hostile criticism is that a large number of tuberculin tests are performed by the farmers themselves. The State Agricultural College met with a storm of opposition from the veterinary interests when it first advocated this policy, but has steadily adhered to it, and believes that the method is thoroughly justified by the results. After I left Madison I had many opportunities of discussing this point, both with men whom I met in Washington at the Tuberculosis Congress and in the course of my visits to several other towns in the Eastern States. Opinions were by no means unanimous. Several men, including prominent veterinary authorities spoke with approval of the policy adopted in Wisconsin. The adverse criticisms may be summarised as follows:—(1) The encouragement of the farmers to do the testing themselves was detrimental to the interests of the veterinary profession. (2) It was undesirable to place tuberculin in the hands of farmers, since it gave them the opportunity for “doping.” (3) The farmers who performed the test lacked the requisite scientific and clinical knowledge; the test was often applied to animals which were not in a suitable condition for it, and consequently a large percentage of error crept in, rises of temperature supposed to be diagnostic being frequently obtained when they were really due to some other cause. (4) These blunders gave the tuberculin test a bad repute and deterred farmers from availing themselves of its advantages when employed by skilled veterinarians.

With regard to these four points I think the following comments are justifiable. (1) It would certainly be to the interests of the veterinarians to be employed in making the tests which the farmers now do for themselves. (2) The farmers have to give an account of all the tuberculin they receive; possibly a few of them try to use it dishonestly, if they think they can

escape detection ; but the unscrupulous farmer who wants to "dope" has never any difficulty in obtaining tuberculin privately from a commercial firm. (3) I have not been able to obtain any precise or published statement as to the magnitude and nature of the farmers' errors ; it would be interesting to know how often this alleged lack of knowledge leads him (*a*) to record an apparently tuberculous re-action in a non-tuberculous animal, or (*b*) to miss a tuberculous re-action in an animal which ought to have given it ; the former mistake, however undesirable, is obviously less detrimental to the suppression of tuberculosis than the latter. (4) I have been unable to find any evidence that the action of the Wisconsin farmers has damaged the repute of the tuberculin test.

In conclusion, there may possibly be some little element of truth in the adverse criticisms directed against the Wisconsin methods ; precisely how much I do not feel competent to say. It is clear that these criticisms are actuated, to some extent, by a feeling that the Wisconsin authorities are interfering with the legitimate pecuniary interests of the veterinary profession. With regard to purely disinterested scientific considerations, there is a complete consensus of opinion that the diagnosis of tuberculosis by the tuberculin test demands both care and skill. In this connection it must be pointed out that the Wisconsin farmers have received instruction in the work at the Agricultural College, and have obtained more practical information about the test than is possessed by many veterinarians in remote country districts of the Western States ; they are not entrusted with the diagnosis, but merely with the inoculations and taking of temperatures ; the diagnosis is made by highly competent authorities at the Experiment Station, after careful scrutiny of the records, and rejection of all charts showing signs of careless work. Apart from the desire not to incur unnecessary expense, an intelligent farmer, with these facilities at his command, has reasonable ground for thinking that he can do the work as well as a good veterinarian, and better than a veterinarian of doubtful reliability. It is also worth noting that in States where the work of tuberculin testing is mainly in the hands of veterinarians, I have not found more tangible evidence of progress towards the eradication of the disease than I have found in Wisconsin.

PENNSYLVANIA.

During my visit to Philadelphia I obtained valuable information concerning the control of bovine tuberculosis in Pennsylvania from Dr. Leonard Pearson, the State Veterinarian.

In the Commonwealth of Pennsylvania the management of affairs is in the hands of the State Live Stock Sanitary Board, constituted in 1895. This Board consists of the Governor of the Commonwealth, the Secretary of Agriculture, the State Dairy and Food Commissioner, and the State Veterinarian. Its duties are "to protect the health of the domestic animals of the State" and "to determine and employ the most efficient and practical

means for the prevention, suppression, control or eradication of dangerous, contagious or infectious diseases among the domestic animals."

Attention may be called to some of the powers conferred on this body. By an Act passed in 1897 they are authorised to prevent the introduction from other States of "dairy cows and such other cattle as are for breeding purposes" which have not passed the tuberculin test. From an Act passed in 1905 "to further define the duties and powers of the State Live Stock Sanitary Board" I quote the following provisions:—
 "Section 1. That all practitioners of Veterinary Medicine in Pennsylvania shall, immediately upon gaining information thereof, report to the Secretary of the State Live Stock Sanitary Board the occurrence among animals of any one of the following diseases. advanced or generalised tuberculosis or tuberculosis of the udder. Section 2. No person who has knowledge of the existence of any one of the diseases enumerated in Section one of this Act shall conceal or attempt to conceal such diseased animal, or knowledge of such diseased animal, from a member or agent of the State Live Stock Sanitary Board. Section 5. The maximum limit of appraisement that shall hereafter be allowed for animals that it shall be deemed to be necessary to destroy, to prevent the further spread of a dangerous, contagious or infectious disease, shall be as follows: For a horse or mule, forty dollars; for a bovine animal, of pure breed or registered stock, fifty dollars; for a bovine animal, of grade or common stock, twenty-five dollars; for a sheep or pig, ten dollars; provided, however, that the amount of appraisement shall not, in any case, exceed three-fourths of the actual value of the animal at the time of appraisement; and provided further that the total appraisements, in any one year, shall not exceed thirty-five thousand dollars."

When a farmer wishes to obtain assistance with a view to eradicating tuberculosis, he is required to comply with certain conditions. These are best explained by quoting extracts from the letter which he must address to the Live Stock Sanitary Board. "I have reason to believe that some of my cattle are afflicted with tuberculosis, and I wish to have my entire herd inspected, and tested with tuberculin, if such test is deemed necessary by your representative, and the diseased animals disposed of according to the rules and regulations of the State Live Stock Sanitary Board. I understand that this inspection and test are to be made at the expense of the Commonwealth and, in consideration thereof, I agree thoroughly to disinfect the premises and correct faulty sanitary conditions and thereafter to observe the precautions and measures and to employ the means recommended by your Board to prevent the re-introduction and re-development of tuberculosis in my herd. In particular, I agree to purchase no cows for addition to my herd until they have been proved by tuberculin test to be free from tuberculosis, and if 20 per cent. of my present herd shall be found to be tuberculous, I will have a re-test made under the supervision of

your Board, at my own expense, within eight months from the time of the State inspection. It is agreed, that cattle showing physical symptoms of tuberculosis or that re-act to tuberculin, shall at once be separated from cattle showing no evidence of tuberculosis, and shall be quarantined; their milk shall not be used for any purpose until it has been pasteurised for ten minutes at 165°F., or has been boiled. The further disposition of such quarantined cattle shall be as follows:—1. Cattle affected with tuberculosis of the udder, or with advanced or generalised tuberculosis, shall be appraised and killed. The carcasses of such cattle shall be disposed of on the farm by cremation or burial, or shall be disposed of through an approved fertilizer works. 2. Cattle that re-act to tuberculin, but that show no physical (external) signs of tuberculosis, may be continued in quarantine, subject to the conditions in respect to separation from sound cattle and the sterilisation or adequate pasteurisation of milk as stated above, and subject to the further provision that calves from cows so quarantined shall, immediately after birth, be removed from contact with quarantined cattle, and from infected premises, and shall be fed with milk from sound cows, or sterilised or adequately pasteurised milk from quarantined cows. 3. Quarantined cattle, as described under paragraph 2, may, upon special permit, be removed to a slaughter-house, there to be killed in the presence of a veterinary inspector of the federal or of a local meat inspection service, or in the presence of an agent of the State Live Stock Sanitary Board. The disposition of the carcasses shall be in accordance with the rules of the United States Meat Inspection Service, or of the State Live Stock Sanitary Board. If, after such inspection, the carcass be passed, the owner shall receive the entire income from the sale thereof, in lieu of indemnity from the State. If the carcass is condemned, it shall be appraised as beef as provided by the Act.” The Act referred to allows compensation at the rate of “not more than five cents per pound for the dressed meat, nor more than twenty-five dollars for the entire carcass.” To obtain the highest rate, the meat must be of the best quality, described as “choice or prime.” Beef which is “medium to good” is rated at 3½ to 4½ cents per pound; an inferior quality, termed in the trade “slippery or cutter,” is rated at 2½ to 3½ cents per pound, and the lowest grade, termed “Bologna or canner,” is rated at 2 to 2½ cents per pound.

In considering the practical working of the above enactments it is instructive to refer to the report made by the State Veterinarian in 1906. In urging the desirability for establishing better methods for dealing with tuberculous cows, Dr. Pearson remarks:—“The State Live Stock Sanitary Board is not prepared to provide compensation for all of the tuberculous cattle that are reported. It is still less prepared to provide compensation for all of the tuberculous cattle that might be found if a systematic inspection of dairy herds were instituted. Consequently, this

outlet for tuberculous cattle, thorough appraisal and destruction by the State is not sufficient. The only other outlet is the slaughter-house, and to butcher milch cows is to incur a great loss. Many of these cows might safely be used for varying periods, up to a few years, in the dairy and for breeding if certain well-known and perfectly well-understood and established precautions were observed. If certain farms could be provided and set aside for maintaining herds of cows that have re-acted to the tuberculin test, this would provide another outlet for such animals If there were a certain demand for re-acting cows from men who would isolate them and keep them under the strict sanitary supervision that would be necessary, an additional encouragement would be afforded the owner of tuberculous cows to get rid of them by providing a higher price than is paid by the State. This would greatly facilitate the concentration and sequestration of infected cows, under conditions where they could be carefully watched and their products pasteurised so that they could do no harm, and would tend to encourage their removal from unwatched, uninspected herds where they now exist in large numbers and where the raw, virulent milk is sent to market without pasteurisation or restriction of any kind. . . . A good deal of progress in the repression of tuberculosis of cattle is being made, but the disease is so widespread and so dangerous that it is desirable that more rapid progress shall be made. The question is largely one of finance.

Treatment of cattle by the Bang method has been recommended to the people of Pennsylvania, but does not seem to have become popular. Dr. Pearson writes:—"It is important to note that the Bang system has never been widely used outside of Denmark, and its use is diminishing rather than growing in that country. That is not because it is not effective—it is effective—but because it involves extra labour, watchfulness, care and expense for such a long time that only a few herd owners have the courage and perseverance to carry it out. It is unfortunate that this is so, for this system furnishes a method to gradually eradicate tuberculosis at a minimum of loss. It is conservative to the last degree. Those who have carried it out correctly have had good results. But we have to take the facts as they are and to recognise that the Bang system in its entirety is not likely to be used extensively in this country."

For several years the question of vaccinating cattle against tuberculosis has engaged the attention of the State Live Stock Sanitary Board, and an experimental herd, containing over 100 animals has been established for the purpose of studying the value of this method. The vaccine used is a slightly virulent virus isolated from the sputum of a consumptive girl. It is of rather low virulence for guinea-pigs, is not virulent for rabbits, and has never been known to cause infection in cattle unless given in enormous dosage to young calves. The method employed is to administer intravenously three successive doses of living bacilli at intervals of from six to eight weeks. In

September, 1906, Dr. Pearson reviewed the results of the work and wrote:—"Not one animal that has been vaccinated in accordance with the method that we are now using has become tuberculous from natural exposure to the disease, nor has an animal been injured by vaccination. With such evidence, covering four years and a large number of cattle, we have felt that we are amply justified in recommending vaccination and in applying it in practice. It is planned to introduce it gradually, using it at first where it is most needed and where the conditions are such as to give it a fair trial. It is for the present applied only by specially trained men from the State Laboratory. Cattle have been vaccinated in nearly all parts of the State, and the method is having a chance to prove its worth under widely varying conditions. It is quite premature to apply vaccination against tuberculosis promiscuously—to exploit it commercially. This control should not be left in the hands of a commercial house interested in placing the greatest possible amount of produce on the market. Vaccination against tuberculosis is free in this State so far as the resources of the State Live Stock Sanitary Board will permit. The process is useful in all breeding herds where there is tuberculosis, and by its use sound animals can be produced from tainted ancestry more easily and surely than by the Bang method, and their continued freedom from infection can be insured. Already prospective buyers are inquiring of me as to where they may find vaccinated cattle, and this preference is likely to increase and to develop a definite market demand."

Some idea of the magnitude of the problem to be dealt with in Pennsylvania and of the public money expended on it by the State may be gathered from the following statistics taken from the Report of the Pennsylvania Department of Agriculture for the year 1906. According to the last available estimate of the United States Department of Agriculture, there were in Pennsylvania 1,141,494 milch cows valued at \$41,093,784, and 984,750 other cattle valued at \$17,479,308. For the year 1906 the State Live Stock Sanitary Board of Pennsylvania had available \$45,000 for its general work in repressing diseases of animals. Expenditures under this fund were as follows:—for tuberculous cattle, \$23,344; for inspecting tuberculous cattle and herds, \$3,886; for horses afflicted with glanders, \$2,941; for inspections for the repression of diseases other than tuberculosis, for vaccination, &c., \$4,293; for the cost of enforcing quarantines, for materials used in making tuberculin, for making and shipping tuberculin, for the diagnosis of specimens, &c., \$3,309; for office and miscellaneous expenses, \$4,554; for the enforcement of the law, requiring the inspection of cattle shipped from other States, \$2,670. For the same year the Veterinarian reports:—"During the year it has been necessary to condemn 1,536 tuberculous cattle from 858 herds. A very much larger number of tuberculous cattle than this is annually disposed of to

cattle buyers, who re-sell them for slaughter. The tuberculous cows that are appraised and paid for by the State are the property of conscientious men who would not knowingly sell an infected animal where it might spread disease, or they are cows that are suffering with tuberculosis in such advanced forms that they are not saleable, or they are cattle that re-act to the tuberculin test when this test is applied to the entire herd."

With regard to the Pennsylvania method and its working, the following observations may be offered.

1. Three types of tuberculosis in cattle are regarded as particularly dangerous, and concealment of these is prohibited by law. These are :—(a) advanced tuberculous, (b) generalised tuberculous, and (c) tuberculous of the udder.

2. The total annual sum available for compensation is obviously insufficient to do much towards eradicating the disease.

3. Farmers are invited to apply to the Sanitary Board for the testing of their herds. I understand that applications are so numerous that it is impossible for the Board to grant an inspection in every case. An effort is made to select for inspection those herds which, from the description furnished by the farmer, are most likely to contain diseased animals. When herd owners desire an inspection, but have no special grounds for thinking disease exists, they may obtain it, but must pay for it; if the herd is found to be free from tuberculosis they receive a certificate of health.

4. When a farmer is to have his herd tested free of charge, and to receive compensation for re-acting animals, he must sign an agreement, the gist of which is that the State will clean up the man's herd, provided that the man will keep it clean. The State forthwith performs its part of the bargain, but is there any adequate guarantee that the farmer will perform his? I was not able to obtain any statistics as to the number of herds, inspected free of charge by the State, which have remained clean. It seems difficult to understand how this "agreement" can be regarded as a valid contract, with a legal sanction behind it compelling the farmer to fulfil his part of the bargain.

5. When the farmers keep their re-acting animals in quarantine, under the requirements specified, it must require a large amount of vigilant State supervision to see that these requirements are faithfully observed, and continue to be so observed.

6. The permanent value attaching to the assistance afforded by the State must depend on the enterprise of the individual farmer, on the earnestness of his desire to keep his herd free from disease, and on the facilities for his doing so on a basis commercially satisfactory to him.

7. It seems that the existing regulations have not been effective in preventing the sale of milk containing living tubercle bacilli.

8. Dr. Pearson's scheme for utilising infected cows on a commercial basis is interesting; but under present conditions, at

least in most countries, it seems to be more profitable and more feasible to conceal, or not seek to discover, the condition of such animals, and to obtain for their products the same market value as that obtainable for the products of healthy animals.

9. It is significant and disappointing to find that the Pennsylvanian farmers, though apparently desirous of eradicating tuberculosis and aware that success must depend largely on their own efforts, have not made more use of the Bang system.

10. Dr. Pearson has done a great deal to stimulate interest in vaccination against tuberculosis, and in many parts of the States I have heard favourable opinions of his work. The method of keeping down tuberculosis by means of vaccine treatment is very commonly spoken of as "the Pearson method." At a large dairy farm which I visited in the State of Maryland I was told by the owner, who was exceptionally well informed and enterprising, that the elimination of tuberculosis from his cattle was largely due to the vaccine treatment which had been carried out under the direction of Dr. Pearson. Results such as these are distinctly encouraging; but it seems safest, at present, to regard the method as still on its trial, and to remember that its reliability has not been substantiated on so extensive a scale as has that of the Bang method.

11. Statistics indicate that much remains to be done before tuberculosis can be eradicated from the very large number of dairy cattle in Pennsylvania. I am told that progress is being made, though perhaps slowly, and that the inspections of animals slaughtered for meat indicate some diminution in the amount of tuberculosis. The work of the Pennsylvanian Live Stock Sanitary Board has a high reputation throughout the United States.

MASSACHUSETTS.

During my stay in Boston, Dr. Austin Peters, Chief of the State Cattle Bureau, kindly provided me with information concerning the methods of dealing with bovine tuberculosis in Massachusetts.

In 1892 the Massachusetts Legislature declared tuberculosis to be one of the contagious diseases of animals, and the control of the disease was taken in hand by the Board of Cattle Commissioners. During their first year of office this Board destroyed 81 tuberculous cattle without appraisal or payment. In 1894 the Board introduced the use of tuberculin for diagnosis and employed it on a large scale. The test was applied to all cattle quarantined on suspicion by loyal inspectors, and upon cattle brought into Massachusetts from adjoining States. The Commissioners also commenced a systematic testing of entire herds and declared that it was their intention to test all the herds in the State and kill re-acting animals, starting in the South-east corner. In this year it was provided that one-half the value of cattle killed as tuberculous by State authority should be paid by

the Commonwealth, the appraisal to be based on the value of the animals for food or milk. In 1895 the law regarding compensation was changed, and the full appraised value (not exceeding \$60) for each animal killed was allowed, provided that the condemned animal had been owned in the Commonwealth for at least six months prior to condemnation. In 1899 the limit of value for a tuberculous animal was reduced to \$40. In 1902 the Board of Commissioners was abolished and their powers were vested in one man, the chief of a newly constituted Cattle Bureau. The cost to the State of compensating for cattle under the auspices of the Cattle Commission or Cattle Bureau is shown in the following table:—

Year.			Number of Cattle killed.	Amount paid for Cattle.
				\$
1896	...	...	5,748	189,216
1897	...	...	5,529	188,534
1898	...	...	297	8,057
1899	...	...	785	17,277
1900	...	...	1,423	30,870
1901	...	...	1,341	27,424
1902	...	...	1,001	21,137
1903	...	...	1,843	42,454
1904	...	...	1,658	35,546
1905	...	...	1,625	34,133
1906	...	...	1,737	35,952
1907	...	...	2,030	42,326
Totals.			25,017	\$672,842

During the 12 years recorded the average price paid per head for the cattle killed is \$26.89. The maximum average price per annum was \$34, paid in 1897. Since then the average price has diminished, and during the last few years it has been between \$20 and \$21. Dr. Peters explains these fluctuations as follows:—"The reason for the high prices paid in 1896-97 was due to the fact that all animals quarantined by the local inspectors and many large herds were tested with tuberculin, and all re-acting animals killed, no matter how slightly diseased they might be, and many of these animals were apparently in good physical condition, while at the present time only animals that show marked physical evidence of disease, or that have nodulated udders, are killed, and nearly all are condemned on a physical examination."

It will be noted that in the years 1896-97, the sums expended were very large. The experience of these years revealed the wide extent to which tuberculosis was prevalent, and the enormous cost of the project on which the authorities had embarked. Then a re-action set in, which is well shown by the relatively small sums expended in the two following years,

After this period, as the annual expenditures show, there was a renewal of enterprise, but on a much more modest and less expensive scale than in the first two years.

Has the Commonwealth of Massachusetts obtained good value for its money? In answer to this question I quote the following remarks of Dr. Peters:—"It is doubtful if the work at present being carried on against bovine tuberculosis in Massachusetts accomplishes much in the direction of decreasing the percentage of tuberculosis among the herds of the State, as a fresh crop of badly diseased cattle, mostly cows, is harvested year after year; if anything, it would appear that there is a slight increase, as the number of condemned cattle has gradually increased a little, varying somewhat from year to year, from 1,423 in 1900 to 2,030 in 1907. To do more work and gain greater headway, larger annual appropriations for the use of the Cattle Bureau will be needed. The greatest possible amount of work is being done with the means available at the present time."

With a view to protecting the Commonwealth against the introduction of tuberculosis from other States or countries, it is enacted that cattle imported into Massachusetts shall be delivered directly to special quarantine stations at one of three places, Watertown, Brighton and Somerville. They there come under the following restrictions:—"All cattle, except those for immediate slaughter, or calves under six months old, intended to be kept in the State permanently, must be tested with tuberculin by an agent of the Cattle Bureau after arrival at destination, the only exception being cattle brought in from foreign countries which have passed a test given by an agent of the United States Bureau of Animal Industry."

Over 21,000 head of cattle are brought into the State annually for dairy and breeding purposes, and as these are tested, there is a large number of reliable animals available for purchase. Commenting on this fact, Dr. Peters remarks:—"If every farmer when he buys a new cow would disinfect the stalls where the old ones stood, and then buy only tested cows to replace the old ones, there would be much less tuberculosis than there is to-day among the milkmen's herds in Eastern Massachusetts; but, as it is, many of these healthy cows are taken to infected barns and later sold to the State or to the bologna sausage maker because they have gone to pieces with tuberculosis. The average milkman will buy any good-looking cow he sees on the Brighton market and does not seem to care whether she is a healthy tested cow from without the State or an untested Massachusetts cow."

There is a special restriction on the use of tuberculin in Massachusetts, the law being as follows:—"Tuberculin as a diagnostic agent for the detection of tuberculosis in domestic animals shall be used only upon cattle brought into the Commonwealth and upon cattle at Brighton, Watertown and Somerville; but it may be used as such diagnostic agent on any animal in any other part of the Commonwealth, with the consent in writing of the owner or person in possession thereof, and upon

animals which have been condemned as tuberculous upon physical examination by a competent veterinary surgeon. Such tests by the use of tuberculin shall be made without charge to citizens of the Commonwealth, and in all other cases the expense of such tests shall be paid by the owners of such animals or by the person in possession thereof."

With regard to the work in Massachusetts the following observations may be made.

1. As soon as the authorities attempted to destroy animals on a large scale they found it necessary to give compensation.

2. Owing to the enormous cost which would have been involved, the original project of systematically working through the country and wiping out every animal which re-acted to the test had to be abandoned.

3. An additional feature of extravagance in the early part of the work was that all meat from re-acting animals, however slightly diseased, was regarded as unfit for food. This was rectified in 1898, when the principles of the United States Bureau of Animal Industry regarding the condemnation of carcasses were adopted.

4. In the earlier dates, at least, the farmers do not appear to have appreciated the spirit in which compensation was offered. I am informed that they did not treat it as an incentive to get rid of tuberclosis, but desired to avail themselves of the help of the State "as a matter of speculation, with the idea of selling a lot of old milked-out cows to the Commonwealth for more than they were worth."

5. The average price paid in compensation has fallen from \$34 to about \$20, the reduction being due to the fact that at the present time only animals which show marked physical evidence of disease are killed. This cannot be regarded as pure economy unless it can be shown that the less severely diseased animals are dealt with in a satisfactory manner. If these latter animals are allowed to live until they become severely diseased and to disseminate the disease to others, the compensation for the badly diseased animals will do nothing towards checking tuberculosis, but will rather encourage its propagation. To encourage a farmer to make all the profit he can out of a cow until she is broken down with disease and then to give him a solatium of \$20 would be an ideal method of fostering and disseminating tuberculosis.

6. The Chief of the Cattle Bureau thinks that tuberculosis has not diminished, but that "if anything" it has slightly increased. He adds that to "gain greater headway" the expenditure of more money is necessary.

7. Massachusetts, like most of the States which I have visited, is extremely anxious not to be made the dumping ground of the tuberculous rubbish from other States. This is perhaps one of the more encouraging features in the American campaign against bovine tuberculosis. Nothing stimulates the enthusiasm of a State more readily than the fear that its neighbours are

trying to impose on it. It is easy to get money voted for the purpose of defeating the supposed sinister designs of other communities, and a good deal of trouble is taken to see that the work is done effectively. The consequence is that in the large number of reliably tested cattle which come in from other States the farmer has a valuable source from which to replenish his herds.

8. In order to reap the full financial advantage from these imported cattle the farmer should not merely avoid introducing them into infected barns, but should see that they are allowed to associate with none but healthy tuberculin-tested animals. But without the adoption of systematic tuberculin testing in the home dairies this is not possible. Owing to the limited use of tuberculin in Massachusetts, it seems that the danger of infecting imported cattle by contact with home-bred cattle is not adequately guarded against, and consequently the care taken to secure a yearly influx of healthy cattle does not seem to result in a permanent addition to the healthy stock of the community.

MINNESOTA.

Whilst travelling in this State, I spent some days in Minneapolis and the adjoining capital city of St. Paul. At the latter city I visited Dr. Bracken, Secretary of the State Board of Health for Minnesota, and through his kindness was put in touch with the veterinary department of the sanitary service.

The central authority responsible for the control of bovine tuberculosis is the State Live Stock Sanitary Board. This Board consists of five members. It is enacted that "three shall be persons financially interested in the breeding of live stock in the State; and the other two practising veterinarians and graduates of a regularly organised and recognised veterinary college." It is unlawful to bring into the State animals which have not been examined and found free from disease, and in the case of cattle the tuberculin test is demanded. When convicted of violating this law, "any transportation company, corporation, or agent thereof shall be fined for each offence not less than \$500, nor more than \$1,000, or be imprisoned for not more than one year."

Provision is also made for the testing, by officials of the Board, of herds of cattle within the State, and compensation is given for animals which re-act and are condemned. The animals are appraised, the maximum appraisal being \$35 for a cow of common stock and \$75 for a pure-bred cow. If upon slaughter the animal is found free from disease, the owner receives the full amount of appraisal, less the value of the carcass. But if the animal is found diseased, "the value of the carcass shall be deducted from the appraised value of the living animal, and three-fourths of the remainder shall be paid to the owner by the State, *provided*, the animal has been kept for one year in good

faith in the State prior to killing thereof." In commenting on these maximum values for appraisal, which appear to have been fixed on the assumption that condemned animals could, for purpose of appraisal, be regarded as sound animals, the Attorney-General has declared that it is unconstitutional to appraise animals infected with tuberculosis as sound animals, and that they should be appraised "at their actual cash value immediately prior to killing."

For the year ending July 31st, 1907, the State tested 18,022 cattle, including 1,957 imported cattle, and killed, on account of tuberculosis, 1,165, out of which 54 were imported cattle. The statistics of cattle tested within the State are tabulated according to the counties where they are located, and my attention was called to certain counties which show a relatively low percentage of infected animals. I select the following examples:—

County.	Number of Animals Tested.	Number Killed.
Hennepin	4,856	184
Ramsey... ..	3,402	102
Rice	1,071	58
St. Louis	1,831	36

As a further illustration of the amount of work done and the cost of compensation incurred by the State, the assistant secretary kindly copied out for me the statistics for the year ending July 31st, 1908. The number of pedigree cattle tested was 1,329, and of these, 490 re-acted, or 36·8 per cent. Of the re-acting animals, 428 were killed, 199 of them being passed as fit for food and the rest condemned. The appraised value of these 428 animals was \$27,770 (average \$63·94), the value of the carcasses \$5,296; and the amount due from the State for compensation was \$17,460. The number of cattle belonging to common stock which were tested was 25,887. Of these, 2,000 (or 7·72 per cent.) re-acted, and 1,940 were then killed. 851 were passed as fit for food, and 946 were condemned. In 52 no lesions were found, and consequently the State was required to pay the full appraised value of these. The total appraised value of all the animals appraised was \$51,027, and the amount due from the State as compensation for them was \$27,104. The tuberculin used in the above tests was received free of charge from the Bureau of Animal Industry at Washington.

The Secretary to the Board has been endeavouring to convince dealers that it would be profitable to establish a business confined exclusively to cattle proved by the tuberculin test to be free from disease. In his report for the year ending July 31st, 1907, he states that a firm has established business on these lines. They buy Minnesota cattle at their own risk and get them tested and tagged by the Live Stock Sanitary Board free of charge, as

the Board thinks that an enterprise of this nature deserves encouragement. It is stated that dairymen who desire such cattle may buy from this firm "at practically the same price as that asked for untested cattle." If this is the case, it is difficult to see what commercial advantages the firm in question has been able to secure for itself.

With regard to the working of the Minnesota system, I found that opinions differed as to the amount of substantial progress which had been made towards the eradication of tuberculosis. Some people considered that the results were highly satisfactory; others were less sanguine. Last season a Bill was brought before the Legislature proposing the compulsory testing with tuberculin of all cattle within the State. The Bill was rejected, as it was recognised that the amount and cost of the work involved would be so great as to render the task impossible. I was unable to obtain statistics as to the percentage of cattle in the State which have not yet been tested. The figures I have quoted show that a good deal of work is being done and that the State is willing to expend a fairly large annual sum in compensation. Is the State obtaining good value for its money? Is the percentage of healthy stock increasing? I was not able to obtain the data requisite to formulate an answer to these questions on a statistical basis. What seemed to me the most interesting feature about the work was the widespread desire to enhance the reputation of Minnesota as a State possessing a large number of tested and healthy cattle. The commercial advantages of such a reputation are recognised; and as any claims to this reputation are always keenly criticised by commercial rivals, there is a strong incentive to continue the work along lines yielding substantial evidence of progress.

NEW YORK STATE.

Whilst at Ithaca I had the opportunity of discussing the subject of bovine tuberculosis with Professor Veranus A. Moore, of the New York State Veterinary College of Cornell University.

The State of New York vests important powers in the Commissioner of the Department of Agriculture. He may direct that an animal shall be condemned, quarantined or slaughtered as tuberculous if it shall be found to be tuberculous by a physical examination. If the owner of animals suspected of being tuberculous desires to have such animals tested with tuberculin, a test shall be made by a medical or veterinary practitioner designated by the Commissioner, provided that the owner first enters into a written agreement that he will disinfect his premises and either consent to the slaughter of the animals responding to the test or hold them and their products in strict quarantine, pursuant to the Commissioner's directions. The Commissioner may also, "in his discretion," order a tuberculin test to be made, and may cause re-acting animals to be slaughtered or held in strict quarantine. The written agreement which the owner has to sign contains ten requirements, *viz.*, (1) separation of healthy

animals from all animals having or suspected of having tuberculosis, (2) disinfection, (3) improvement of faulty sanitary conditions, (4) to allow a re-test at such time or times as the Commissioner deems necessary, in case tuberculosis is indicated by the tuberculin test, (5) to permit the slaughter of any animal having tuberculosis of the udder "or the disease elsewhere so far advanced as to be indicated by physical examination," (6) to quarantine or "properly dispose of" all other re-acting animals, (7) to carry out such other measures as may be recommended by the department to maintain the herd free from tuberculosis, (8) "not to use or sell for food or feeding purposes any milk from an animal believed, after a physical examination, to have tuberculosis; nor to sell such milk for any other purpose except upon approval of the Commissioner of Agriculture," (9) "not to use for sale, feeding or otherwise, milk from any other animal believed, after a tuberculin test, to have tuberculosis, unless such milk has been pasteurised at 185° F.," (10) "not to add any animal to the healthy herd unless it is found to be free from tuberculosis (by tuberculin test, if such test was used for the herd; and by at least two tuberculin tests if the animal to be added came from an infected herd)." Three different methods of examining herds are offered by the State, and the applicant is required to say which he wants. These methods are—(1) the tuberculin test, (2) physical examination + a tuberculin test, if the physical examination indicates the presence of tuberculosis, (3) physical examination alone.

Under the direction of the Commissioner there is a Chief Veterinarian who has general charge of the enforcement of the Act relative to the control of bovine tuberculosis and is also required to disseminate through farmers' institutes or otherwise, information concerning the care of animals, the prevention of disease, methods of feeding, and methods of improving the breed or milking qualities of cattle.

Compensation is given under certain conditions, the maximum appraised value being \$75. When an animal on slaughter is found to be free from disease the full appraised value is given; if the animal has localised tuberculosis the owner receives 80 per cent. of the appraised value; and if the animal has generalised tuberculosis the owner receives 50 per cent.

The laws of New York State relating to disease of domestic animals have been frequently revised; the extracts quoted above are from a copy of the law as amended up to July 1st, 1908.

How much has already been accomplished in New York State? Professor Veranus Moore, who holds a high reputation throughout the States as a careful and impartial critic, does not take a very favourable view. The amount of money voted for the execution of the law has varied from year to year, and prior to 1907, when it was \$50,000, the sum has not exceeded \$35,000. As the expenses involved by other infectious diseases of animals, including rabies, anthrax, and glanders, have to be paid out of this fund, the amount left for tuberculosis has been entirely inadequate

for effective work. Writing in October, 1907, Professor Moore says :—" The law, although carried out, has not had the effect of reducing permanently the amount of tuberculosis in the cattle of the State. As interpreted and executed, herds, or as many of them as the available funds permit, are examined when their owners apply for such examination, or upon the complaint of those suspecting that milk is being sold from diseased cows. The latter class of cases, when investigated, is under authority of a statute relating to pure milk. While the statute provides for proper disinfection it does not make provision for retesting and the further elimination of re-acting animals. The result is that within a few years after the re-actors are killed the herd is liable to be as extensively diseased as in the beginning, because of the holding over of animals which were infected at the time of the test but in which the disease had not begun to develop or in which it was temporarily healing. Under such conditions the State can continue to buy diseased animals, as the cattle owners are continuing to raise tuberculosis ones. . . . The New York law does not seem to fully take into account the nature of the diseases it is supposed to control. This is specially true of tuberculosis, for the statute concerning it does not seem to be intended for the carrying out of efficient and systematic methods for its eradication but rather to simply touch in a palliative way the herds here and there where it is or where it is thought to be most apparent and its effects most distressing."

CONCLUSIONS AND SUGGESTIONS.

Is it possible to eradicate bovine tuberculosis? In recording the information which I have obtained from America, I have given prominence to what seem encouraging features in the problem: and from these it would appear that under specially favourable conditions, where the farmers are enterprising, well informed, and prosperous, where the country is comparatively new and thinly populated, and where the proportion of infected to healthy animals is relatively low, areas of considerable size may become eventually free from the disease. But, regarding the conditions of the country as a whole, the general outlook is not hopeful. The disease is so widely disseminated, and the economic obstacles to its elimination are so excessively great, that it is impossible, even by a generous interpretation of the efforts which are being made, to put together tangible evidence of substantial success on the lines which have hitherto been followed. Tuberculosis progresses so insidiously, persists so long before manifesting its presence by physical signs, and has taken so firm a hold on the stock of the country, that there is not the least hope of being able to stamp it out by the application of any simple and drastic measures which have been effective in eliminating other infectious diseases. This, I consider, is the first lesson to be learnt from the disappointing results which have attended some of the American schemes. *It is, so far as my observations enable me to speak, unless to attempt the formulation of any general*

plan for the complete eradication of bovine tuberculosis throughout this country within a limited period.

As the embareation on too comprehensive a scheme leads to failure and the wastage of public money, it is evident that the problem must be attacked piecemeal. In arranging a plan of campaign the first thing to decide upon is how to dispose of the rubbish, *i.e.*, dairy cows which are so obviously diseased that they have no market value as live stock. They must be destroyed. This is a necessity about which all American authorities are agreed. It is a matter of importance to define the essential reason for this necessity, and upon this point I have had several discussions with my American friends. Their general opinion, which I believe to be thoroughly sound, is that the community must view the question from the commercial standpoint, and that the essential reason why these animals should be destroyed is that they are a menace to the agricultural interests of the community. Obviously the interests of public health are also involved; but as they are coincident with those of agriculture in this matter, it is an advantage to avoid complicating the problem by their introduction, and to deal with the question on purely commercial lines. *It is imperative in the interests of agriculture, that dairy cows with advanced or generalised tuberculosis, or with tuberculosis of the udder, should be destroyed.*

In order to discover these dangerous animals an efficient service of inspectors is required. This is essential before any further progress can be made towards eradicating the disease and the use of public money for this purpose is requisite. *The public must be prepared to meet all the cost of adequately inspecting the condition of dairy cattle.*

In addition to bearing this cost, it has been proposed that the State should pay compensation for the condemned animals. When cattle are so obviously infected with tuberculosis that the owner can get nothing for them in the open market as live stock, why should the State pay for them? This is a topic upon which American experience of compensation throws useful light. My study of the problem has led me to form the following opinions. The amount of money which even the richest community can afford to spend in the interests of agriculture is limited, and usually appears insufficient to meet all the reasonable demands which agriculture may make upon it. It is therefore necessary to consider how the sum available can be spent most usefully. If the State compensates for tuberculous animals which are worthless on the open market, will the money so spent be productive, in the economic sense of the term, *i.e.*, will it increase the food producing value of the herds in the community? Emphatically, no. It is impossible to study American experience of compensation without forming a definite opinion on that point. When a herd contains animals broken down with tuberculosis, it practically always contains also other animals in a less advanced, but progressive, stage of the disease. The mere elimination of the former animals does not produce a clean herd; the other infected animals gradually develop the condition of

those already slaughtered, and continue by their faecal and other discharges, to pass on the infection to new arrivals. So the process goes on indefinitely, and the payment of compensation for broken-down beasts is a positive encouragement for its continuation. Public money expended for this purpose is worse than wasted; by rewarding the farmer who is unwilling or unable to adopt effective measures of control, it actually aids in the continued propagation of the disease, and so contributes to a further diminution of the food-producing value of the live stock in the community. No community which is seriously desirous of fostering commercial interests can be justified in adopting this suicidal policy. *It is essential, in the interests of agriculture, that compensation should not be paid out of the public funds for slaughtered cattle showing advanced or generalised tuberculosis, or tuberculous of the udder.*

The next step towards the eradication of tuberculosis is to discover and separate the uninfected animals and the animals which are in an early stage of the disease. For this purpose the use of the tuberculin test is necessary, and a repetition of the test, some months later, on each non-reacting animal is desirable. And as a healthy animal is in constant danger of infection unless separated from infected animals, the search for healthy animals must include the testing of all animals with which non-reacting animals are in contact. This means the adoption of tuberculin testing on a large scale, and to entire herds. Most of the American workers recognise the importance of this principle that in order to profit by the information which the test affords it is necessary to extend the test to every animal in a herd. If the test is to be of value in the suppression of disease, it must be employed as a necessary guarantee of health, not merely as an aid to diagnosis in cases where disease is suspected. A man will never clean up his herd if he relies on the tinkering policy of waiting until a cow shows suspicious signs, getting her tested, weeding her out, and then waiting until the next suspicious case arises. But here the average farmer is confronted with a serious and very often an insuperable, practical difficulty. Tuberculin testing requires skill and costs money. To quote an example, the managing director of a large firm of milk contractors in this country recently told me that whenever the firm's inspector found a suspicious case, a sample of milk was sent to a competent veterinarian for microscopic examination. If the veterinarian reported that tubercle bacilli were present, the cow was at once eliminated; if the veterinarian did not find tubercle bacilli, the cow was subjected to the tuberculin test. The reason that the firm resorted in the first instance to such a notoriously uncertain test as microscopic examination of the milk was a desire to save the expense of the tuberculin test whenever it was possible to make the diagnosis without it, the charge for the tuberculin test being two guineas per cow. This illustration shows the absurdity of expecting an ordinary farmer to test his entire herd at his own expense. In many parts of America the State offers to come to the aid of the farmer and to do the testing of all his cattle

free of charge, provided that the farmer will enter into an "agreement" to take certain steps towards the eradication of tuberculosis. The aspect of this system, which seems deserving of admiration and imitation, is the offer of the State to test the farmer's entire stock. The feature which appears less commendable is the "agreement," since there is not adequate provision for compelling the farmer to fulfil all he contracts to do. Many of the clauses in the agreement are often a dead letter, not worth the paper they are printed on; the offer of such a contract is bad business, and therefore bad policy. Substitute for the "agreement" payment in cash, and the method would be admirable. On receipt of a minimum fee from the farmer, say two guineas, the public authority might undertake to send a skilled veterinarian, well acquainted with the agricultural conditions of the district, who should test all the farmer's cattle, inspect his premises, offer suggestions as to the best methods of dealing with the re-acting animals, and, if desired to do so, discuss and advise upon the farmer's business affairs in connection with his cattle. And there the transaction should end. No interference, coercion, or compulsory slaughter; no compensation; and no promises for the future. In some cases, farmers living near together might combine and so reduce the expense. The fees would not cover the cost of the work, but they would be the best guarantee available that the farmers were able and earnest in their desire to improve the general condition of their stock; and this guarantee might be taken as sufficient to justify the requisite expenditure of public money on the work of testing. It would be desirable to have all the tuberculin prepared in a central laboratory supported by Imperial funds, and, in order to facilitate the requisite central supervision and control, it would be advantageous to require that reports of all the tests made, and of their results, should be sent to the central laboratory. In Washington, for example, the Bureau of Animal Industry furnishes tuberculin to Federal, State, County, and City officials on condition that the testing shall be done by skilled persons under official supervision, and that the results of the work shall be reported to the Bureau. When visiting their laboratory I was informed that for the year ending June 30th, 1908, 215,000 doses were sent out, and that their cost, including all working expenses, bottling and packing, amounted to about two cents per dose. The above considerations may be summarised as follows:—
The testing of entire herds with tuberculin should be encouraged, and for this purpose the assistance of public money is requisite and desirable.

In considering what further expenditure out of available public funds may be devoted to the agricultural interest, it is again useful to learn a lesson from American experience. In the campaign against bovine tuberculosis the strength of the enemy is so overwhelming that money expended on a frontal attack is generally money wasted. The public money spent on badly infected herds, spent on merely reducing the amount of disease without completely eradicating it, is rarely of permanent value.

It would be better to begin with the easier and less expensive task of seeking the healthy herds, trying to keep them healthy, and trying to increase their number. When on the first test no re-acting animals are found, practical encouragement might be given to the farmer by offering to tag all his animals for him, and, on condition that he introduces no fresh beasts among them, to give him a second test free of charge. If the second test, which should be made without warning, confirmed the first, the farmer might feel reasonably confident that he possessed a healthy herd. A herd which has successfully passed two successive tests gives a better foothold for fighting the disease than six herds which have passed only one test. A further step would be to fix a minimum percentage of reactions, and to extend the same offer to farmers whose herds, on the first test, gave a percentage of reactions below this minimum, provided that the re-acting animals were at once separated; then, if the second test revealed no reactions, to offer a third free test. A slight increase in the number of thoroughly sound herds means substantial progress, and justifies the money spent on it. *Public money spent on re-testing, with a view to establishing thoroughly the soundness of herds giving on the first test either no reactions or only a small percentage of reactions, would be money well spent.*

With regard to the re-acting animals, it must be freely admitted that the farmer has an extremely difficult task. Can the State help him? It is obvious, from what has been tried in America, that the amount of financial aid which the State can afford to extend to him, if it can afford any, will only go a small way; and as a corollary from American experience it is clear that the State is not likely to get good value for its money, *i.e.*, bring about an increase in the productive value of farm stock, unless the offer is made with due regard to commercial principles. The following considerations, arising partly out of Dr. Pearson's suggestions for the segregation of re-acting but clinically healthy cows may be mentioned. In fighting a disease which is constantly spreading, it is very important, especially at the start, not merely to secure thoroughly healthy foci and to increase their number, but also to increase the number of these areas quickly, so that the healthy zones may expand or multiply at a more rapid rate than the extension of the disease. As the saving of time means the saving of money, there is a *primâ facie* case for asking the State if it will aid such an enterprise. To suggest a possible instance; in a district where the value of the tuberculin test is appreciated, and where it is possible to replenish stock by the purchase of clean animals, there may be found perhaps a dozen herds, in each of which the re-acting cows are few in number and possess a fairly good market value. If the owners of these are merely advised to adopt the Bang system, it will take several years before any of the twelve farms are completely cleaned up, and probably some of them never will be. But if the infection could be removed from all these farms at once, it would be a substantial benefit to the community at large. To secure this result

promptly might be worth the expenditure of public money. On this account the local authority might be justified, in certain carefully selected cases, in offering to buy up all of the re-acting animals on generous terms, viz., at prices based on the assumption that the animals were all worth what they would be if treated on the Bang system with the maximum possible care and skill. As this would be above the market price, a private dealer could not afford to offer such generous terms; therefore there would be a strong inducement for the farmers to accept these terms and to start at once with the advantage of clean herds. The local authority would collect all the re-acting cows in an establishment under its own control, with an official guarantee of the adequacy of the pasteurisation; the business would be conducted as it actually is conducted under the ordinary Bang methods, whether for the supply of public institutions or for the general market. In so far as the farmer would receive more than the market price for his tuberculous animals, he would receive "compensation." This appears to me to be the maximum, at least in the old country, which can under any circumstances be advantageously offered by way of compensation to the individual out of the public funds. *Re-acting animals possessing a market value might under special circumstances be taken over by the community at a price exceeding their market value; but with this limited exception, compensation out of the public funds does not appear to be justifiable.*

There is another way in which the farmer may be helped, by furnishing him with accurate information concerning the financial loss which bovine tuberculosis involves, the economic advantages of getting a clean herd, and practical methods of obtaining a clean herd. In all the American States which I visited there was a consensus of opinion that vigorous educational campaigns on these lines were productive of good. In many of the States the local and the State inspectors and the veterinarians are doing steady work in this direction by talking to the farmers and stimulating their interest in the subject. Publication of practical articles in the local papers and dissemination of pamphlets from the Agricultural Stations are also doing excellent service. I have before me one of the Wisconsin pamphlets. It is something like an electioneering manifesto and is termed "The 'Let Alone' vs. the 'Take Hold' Policy"; the arguments on either side are set forth in parallel columns, with the intention of inducing the farmer to decide for himself that the "Take Hold" policy of getting rid of tuberculosis is the more advantageous. Whilst this kind of literature does good, practical demonstrations are of still greater educational value. In Wisconsin the post-mortem demonstrations at county fairs of re-acting beasts, apparently healthy before slaughter, have proved to be a very powerful argument in favour of employing the tuberculin test. There is another kind of practical teaching which, it seems to me, might be utilised to a greater extent—the force of example. If local authorities had experiment stations devoted to the practical solution of business problems, they

would be more likely to succeed in inducing the farmer to do what he is, or ought to be, told to do. To take a few examples. Farmers are told that when they have got clean herds they must keep them clean. Easier said than done. A single oversight on the part of owners who are keenly alive to the importance of keeping their herds clean may undo the work of years. I visited a farmer who started with a clean herd consisting of very valuable pedigree stock. He lent a bull to a neighbour for a few weeks. Some time after the animal's return tuberculosis broke out. The farmer is a wealthy man and determined to stamp out the disease however much it might cost. After three years he has succeeded, but at the sacrifice of 150 animals, some of them prize winners. For an ordinary farmer, with his living to earn, such a course would have been impossible. In another State I visited a farmer who was making his living out of his dairy and was producing certified milk. His herd was clean; so I was interested to know what precautions he took in buying fresh cows. He considered himself very smart and explained his method with much self-satisfaction; but this explanation convinced me that the care he took did not amount to absolute security against introducing the disease. How long his herd will remain clean is more or less a matter of chance. When the disease breaks out in a previously clean herd, owned by a man with a good local reputation for his care and vigilance, much discouragement is caused, and a general impression may be created that the task of keeping out tuberculosis is so difficult as to be practically impossible. The possession by the local authorities of a clean herd or herds, intended for the supply of public institutions, would be a valuable object lesson. There is nothing impossible about the task of keeping out infection; it is merely a question of exercising sufficient care; and it ought not to be impossible to appoint competent men for the work. The most effective way of teaching the farmer the way to success, is to show him, in his own district, that success actually is being achieved. *Local authorities, by establishing and maintaining clean herds for the supply of public institutions, would provide a valuable means of educating the farmer.*

The above considerations all serve to emphasise the difficulties of making headway against bovine tuberculosis; but it must not be forgotten that these difficulties are no more than commensurate with the magnitude of the financial interests which are involved. At the Tuberculosis Congress in Washington Dr. Melvin, Chief of the United States Bureau of Animal Industry, stated that the loss on animals in which tuberculosis is found in the Federal Meat Inspection Service is estimated at \$2,382,433 per annum; and he estimates that if the same conditions were applied to animals slaughtered without Federal inspection the annual loss on animals slaughtered for food in the United States would be increased to \$4,354,855. Tuberculosis is also responsible for a serious depreciation in the value of stock,

Assuming that living tuberculous milk cows are annually depreciated to the extent of one-tenth of what the loss would be if they were slaughtered, other cattle one-third, and hogs (which usually contract their infection from bovines) one-half, he finds that the total annual depreciation amounts to \$8,046,219. The annual loss from decrease in milk production is estimated at \$1,150,000, and to this must be added considerable loss from impairment of breeding qualities. Taking all these items into account, the annual loss attributable to tuberculosis amongst farm animals in the United States amounts to a total of not less than \$14,000,000. I consider that these figures, whilst not justifying contribution from the public funds of a single cent towards schemes which fail to satisfy the elementary principles of economics, prove that on schemes where the capital expenditure is likely to bring adequate returns, calculable on a financial basis, public money ought to be freely spent and could be well invested. *The difficulty at present seems to lie not so much in the lack of public support of a financial nature as in the lack of evidence that the agricultural interest is prepared to turn to good advantage such effective public support as might be offered.*

PART II.

The Control of the Milk Supply in the Interests of the Consumer.

A.—THE POWERS OF LOCAL AUTHORITIES.

(1.) THE ESSENTIAL BASIS OF AUTHORITY.

Before I left England for America the Medical Officer put me in communication with Dr. Charles Harrington, Secretary of the State Board of Health of Massachusetts, who was highly esteemed on both sides of the Atlantic for his wide knowledge and impartial criticism of questions affecting the milk supply. The news of his death received shortly after I reached the States, disappointed me in the hope that I might receive valuable advice from him. But on my visit to Boston the officials at the State House kindly furnished me with information regarding Dr. Harrington's work, together with copies of some of his latest articles on the milk question.

Dr. Harrington was of opinion that the powers vested in the English local authorities are inadequate. Contrasting English with American methods, he wrote, with reference to his own country :—"In this country, happily, these things are better ordered in those States which have adequate health laws. In Massachusetts, for example, the Local Board of Health of even the smallest town has power to exclude the milk of an infected or simply dirty dairy, whether that dairy be local or far distant, and without anything more than its own order."

It has been my purpose to see how far I can substantiate this criticism by my own observations of American methods. The details of the various systems in vogue in different American cities vary considerably ; but underlying them all there is the general principle that the local authority has the right and the duty of defining the conditions under which milk may be sold without danger to the public health, and of prohibiting the sale, within the area over which it holds authority, of milk not satisfying these requirements. As these requirements include provisions that the milk, from its source to its destination, shall not be exposed to conditions liable to render it unwholesome as food, a powerful control is indirectly exercised upon the producer living outside the district, since he cannot obtain a market within the district for milk not satisfying the local regulations as regards its production and handling.

Regarding the legal basis of the local authority's power an important decision was pronounced by the Supreme Court of the

United States on December 11th, 1905. The action which was then decided had commenced as a criminal prosecution in 1902 and involved the right of the Board of Health of New York City to adopt an ordinance requiring a person engaged in the sale of milk in that city to obtain a permit. Section 66 of this ordinance runs :—"No milk shall be received, held, kept, offered for sale or delivered in the City of New York without a permit, in writing from the Board of Health and subject to the conditions thereof." Simon Lieberman was arrested on a warrant issued by a magistrate, charging him with a violation of this Section. From the Magistrate's Court the case went to the Appellate Division of the Supreme Court, and thence to the Court of Appeals of the State of New York. The findings of these three courts were in favour of the Department of Health, and it was decided by the Court of Appeals that the ordinance requiring a permit to sell milk was reasonable and valid, that it was not unconstitutional, and that the Board of Health acted within the scope of its powers when it adopted the ordinance in question. An appeal was then taken to the Supreme Court of the United States. This court, with the concurrence of all the judges, upheld the previous decision that the ordinance was reasonable, valid, and not unconstitutional. In delivering the opinion of the Court, Mr. Justice Day said :—"That the Board of Health had power to pass the Sanitary Code, which includes this section, is not open to question here, as it has been affirmatively decided in the State Court. The objections on Federal grounds for our consideration are two-fold : First, that the section under consideration devolves upon the Board of Health absolute and despotic power to grant or withhold permits to milk dealers, and is, therefore, not due process of law ; second, that singling out the milk business for regulation is a denial of the equal protection of the laws to people engaged therein. . . . The contention of counsel for plaintiff in error is not that a business so directly affecting the health of the inhabitants of the city as the furnishing of milk may not be the subject of regulation under the authority of the State, but that the Court of Appeals of New York has sustained this right of regulation to the extent of authorizing the Board of Health to exercise arbitrary power in the selection of those it may see fit to permit to sell milk under the Section quoted ; and, thus construed, it works the deprivation of the plaintiff in error's liberty and property without due process of law. We do not so understand the decision of the highest court of New York. . . . There is nothing in the record to show that the action against him was arbitrary or oppressive and without a fair and reasonable exercise of that discretion which the law reposes in the Board of Health. We have, then, an ordinance which, as construed in the highest court of the State, authorizes the exercise of a legal discretion in the granting or withholding of permits to transact a business which, unless controlled, may be highly dangerous to the health of the community, and no affirmative showing that

the power has been exerted in so arbitrary and oppressive a manner as to deprive the appellant of his property or liberty without due process of law. . . . Nor do we think there is force in the contention that the plaintiff in error has been denied the equal protection of the laws because of the allegation that the milk business is the only business dealing in foods which is thus regulated by the Sanitary Code. All milk dealers within the city are equally affected by the regulations of the Sanitary Code. It is primarily for the State to select the kinds of business which shall be the subjects of regulation, and if the business affected is one which may be properly the subject of such legislation, it is no valid objection that similar regulations are not imposed upon other businesses of a different kind."

The precedent established by this legal decision has strengthened the hands of the local health authorities in the exercise of a direct control over the milk supply. Trade interests are very powerful in America, and the milk dealers are well organised ; if they can fight a point, they will. The result of this test case is therefore of very high significance.

Equally essential as a basis for local control and intervention is the support of public opinion. In discussing milk regulations with the health officers in the various cities which I visited, I always found it requisite to discriminate between a rule which is a more or less idle ornament of the sanitary code and a rule which is actually enforced. The difference between the two coincides with the difference between rules which are not effectively supported by public opinion and rules which are. The public authority knows that it is useless to attempt to enforce rules of the former type ; the dealer fears to disobey rules of the latter type, because if he does, legal proceedings will follow, and the publicity given to these in the newspapers will ruin his business.

The above features of the American systems may be summarised as follows. *It is true in fact that in America the local sanitary authority enforces regulations for the control of the milk supply by the exercise of its own unaided powers, and that the exercise of such powers is sanctioned both by law and by public opinion.*

(2.) EXAMPLES OF LOCAL REGULATIONS.

It is frankly recognised in America that what the local authority actually enforces may be less than commensurate with its official code of rules and regulations. A not uncommon American method of setting to work is first to decide what objects ought to be attained, forthwith to pass an ordinance enacting that these objects must be attained, and then to discover how far the ordinance can be enforced. Disadvantages of this method are that the frequent failures to execute the ordinance tend to foster a popular disrespect for authority, whilst the officials concerned, being unable to do thoroughly what they are supposed to do, are encouraged in habits of superficial work. On the other hand it must be recognised that this method is often pursued by earnest

men who find that a "try on" policy, with some admixture of bluff, is the best means of dealing with people of an independent and resistive type; and the existence of a regulation which is perhaps ineffective for the time being may serve as a useful warning of what is likely to be enforced in the future. Looking a little beneath the surface, one finds that the process of establishing a reform in America commonly passes through three stages. First there is the stage of enthusiasm. An ideal set of regulations controlling the milk supply has been passed by a majority vote, and the supporters of the scheme write and talk as though the whole problem had been settled. Then a reaction sets in; it is realised that many of the regulations are too drastic to be enforced, and the candid critic comes forward to declare that the whole scheme is an empty pretence and a humbug. This phase of reaction gradually subsides; it is discovered that after all some small but substantial progress has been made, and the work is continued more cautiously, less ambitiously, and more effectively. In studying American regulations it is useful to bear these general considerations in mind, in order to avoid falling into one of two opposite errors, the error of supposing that much more has been accomplished than is actually the case, and the error of supposing that the so-called reforms are an empty pretence devoid of substantial results.

THE DISTRICT OF COLUMBIA.

During my stay at Washington, Dr. Woodward, Health Officer of the District of Columbia, kindly furnished me with information regarding the milk regulations of this District.

The District of Columbia is an area of 60 square miles, lying between the States of Maryland and Virginia, and consists of the city of Washington together with an outlying suburban area. It is under the direct control of the Government of the United States, and all legislation of any considerable importance affecting it is enacted by the Federal Congress. The administration of affairs is entrusted to a Board of Commissioners, and whilst the general duties of this Board are executive, it has legislative powers in matters not considered of sufficient importance to require reference to Congress.

Special interest attaches to a law, passed by Congress in 1895, which requires that milk produced outside the District of Columbia shall not be introduced for sale in that District unless its production conforms to the requirements of the District, under the guarantee of inspection by the District's agents. Apart from its powers of control over the District of Columbia, Congress has the right to regulate interstate commerce; therefore a law, emanating from this body, which gives a local authority an indirect power of control over producers in States outside its area is of especial significance as establishing a precedent. In view of the establishment of this principle in the District of Columbia, local authorities elsewhere have had less

hesitation in placing similar restrictions on the sale of milk produced in areas over which they have no direct legal powers of inspection.

The clause of the Act of 1895 in which this principle is established runs as follows:—"That no person shall bring or send into the District of Columbia for sale any milk without a permit so to do from the health officer of said District; application for said permit shall be made in writing, upon a form prescribed by said health officer, and shall be accompanied by such detailed description of the dairy farm or dairy where said milk is produced or stored as said health officer may require, and by a sworn statement as to the physical condition of the cattle supplying said milk: *Provided*, that no applicant for said permit shall be restrained from conducting business until said application has been acted upon by the health officer of the District of Columbia or his duly appointed agent. If after examination of said application said health officer is satisfied that said milk will be brought into the District of Columbia for sale or consumption without danger to public health, he shall issue, without charge to the applicant, a permit so to do, on condition that none but pure and unadulterated milk shall be, with knowledge of its impurity, brought into said District; that in the management of said dairy or dairy farm said applicant shall be governed by the regulations of the health office of the District of Columbia, approved by the Commissioners of the District of Columbia, issued for dairies and dairy farms in said District, when said regulations do not conflict with the law of the State in which said dairy or dairy farm is located, and that said dairy or dairy farm may be inspected at any time without notice by the health officer of the District of Columbia or his duly appointed representative: *Provided*, That said permit may be suspended or revoked at any time without notice by said health officer whenever the milk supply from said dairy or dairy farm is exposed to infection by Asiatic cholera, anthrax, diphtheria, erysipelas, scarlet fever, smallpox, splenic fever, tuberculosis, typhoid fever, typhus fever, or yellow fever, so as to render its distribution dangerous to public health."

For producers residing within the District of Columbia the Act contains a similar clause requiring the issue of a permit.

The above legislation has undoubtedly been of great value as establishing a precedent for the formulation in other localities of ordinances based on similar principles.

With regard to the working of the regulations in the District of Columbia, Dr. Woodward states that the total number of farms licensed to produce milk within the District or to send it in from the adjacent States of Maryland and Virginia is 960. Milk is also sent in from twenty farms in Pennsylvania and twenty farms in New York State. The funds available are not sufficient to cover the cost of inspecting these forty farms; they are therefore permitted to send in milk without licenses, under the provision of the law which authorises the sending in of milk

immediately after the filing of an application and until the health officer has investigated the application ; the investigation in these cases is indefinitely postponed. The territory actually inspected is divided into six districts, with one inspector assigned to each. If the inspector finds a farm not conforming to the regulations, the steps taken depend on whether the farm is within or without the District of Columbia. If it is within, the owner of the farm is prosecuted in the police court. If the farm is outside the district, the owner is threatened with withdrawal of the permit ; but unless the violation of the regulations is very serious, or unless similar offences have occurred repeatedly, summary action is not taken, but the offender is given an opportunity of correcting the faulty conditions and of showing cause why the permit should not be revoked.

Dr. Woodward considers that the 1895 law leaves room for improvement, and writes:—"It has been impossible for the health officer to submit to the Commissioners or for the Commissioners to submit to Congress any bill to regulate the sale of milk in the District with the assurance that it would not meet with more or less formidable opposition from persons interested in the production and sale of milk, either individually or as an organisation. The fight to obtain better legislation to regulate the sale of milk has always been carried to the committee room, at the Capitol, and the fight has always been lost." But as evidence that the law, as it actually stands, has been productive of good Dr. Woodward points to the diminution in infantile diarrhœa which has taken place since the law was passed in 1895. During the five years 1880-84, the death rate from diarrhœal diseases of infants was 162 per 100,000 ; during the next five years it was 168, and during 1890-94 it was 175. But during 1895-99 the rate fell to 135 ; during the next five years it fell to 109, and during the years 1905 and 1906 it was, respectively, 104 and 97. Whilst recognising that *post hoc* is not necessarily equivalent to *propter hoc*, Dr. Woodward finds that the only cause which can be reasonably assigned for the improvement shown by these statistics is the institution of a stricter control over the milk supply.

NEW YORK CITY.

The working of the New York system hinges on the regulation that "no milk shall be received, held, kept, offered for sale or delivered in the City of New York without a permit from the Board of Health and subject to the conditions thereof." When an application for a permit is made, a copy of these conditions is given to the applicant and his premises are examined by an inspector. If the character of the premises is such that a permit cannot be recommended, the inspector informs the applicant of the defects which must be remedied, and after a reasonable length of time makes a reinspection. If the conditions are still found to be unsanitary the inspector reports on the facts and

recommends that the application for a permit be denied. Where the conditions are found to be suitable for the proper care and handling of milk, the dealer is recommended for a permit and this is granted by the Board of Health.

From the "Rules and Regulations for the Care and Storage of Milk" I select the following for quotation:—"Milk must not be transferred from cans to bottles or other vessels on streets or on ferries or at depots, except when transferred to vessel of purchaser at time of delivery. . . . The vessels in which milk is kept for sale must be protected by means of a suitable covered receptacle and so placed in the store as to prevent dust from the street or other impurities falling into it."

Section 53 of the Code prohibits the introduction into the city or the offering for sale within the city of any milk which is "adulterated"; and for the purpose of this Code milk is regarded as "adulterated" if it falls under one or more of nine specified definitions. From these definitions I select the following;—(a) "Milk drawn from animals fed on distillery waste, or any substance in a state of fermentation or putrefaction, or on any unwholesome food"; (b) "milk drawn from cows kept in a crowded or unhealthy condition"; (c) "milk the temperature of which is higher than 50° F."

Section 54 ordains that "any milk found to be adulterated which has been brought into the City of New York or is held or offered for sale in said city, may be seized and destroyed by any inspector, or other officer of this Department authorized to inspect milk."

Every applicant for a permit to sell milk either in a shop or from a wagon must inform the Department of the source from which he obtains this milk. This information is followed up by the Department; the sources supplying the place from which the retailer obtains his milk are ascertained, and these are traced back to the actual producers. This is a task of considerable magnitude, since the milk supply of the city is obtained from a very large area, including parts of five different States, and some of it comes from a distance of 400 miles.

The control exercised by the city over milk produced in areas outside its limits is based on the following rule of the Department of Health:—"As a condition to the issuance of permits for the sale of milk in the City of New York, all places where such milk is produced or handled must be open to inspection by employees of the Department of Health of the City of New York." These inspectors have no authority to compel occupants of places outside the geographical limits of the city to submit to inspection, but the threat that refusal will be followed by exclusion of the milk from the city is found to be effective. When the inspectors find the sanitary conditions unsatisfactory, the owner is informed that reform is necessary if he wishes to continue to supply New York City with milk.

Special arrangements have been made to insure the early notification of infectious disease in any person handling milk. The

following regulations affecting the dairy farms and the creameries, or collecting stations which receive and collect milk from individual farms and transfer it to the railway, may be quoted:—

“Every creamery or milk station which ships milk or cream, or both, to the City of New York, shall be required, through its agents, to furnish to the Department of Health of the said city on Monday of each week a report stating the existence or non-existence of any one of the following infectious diseases in the households of all persons employed in the collecting or handling of milk, either at the creamery, or at the farms or dairies supplying it; namely, typhoid fever, tuberculousis, diphtheria, scarlet fever, dysentery, or any other infectious disease.

Every creamery or milk station shall require each dairyman or farmer sending milk or cream or both to such creamery or milk station to report in writing on Saturday of each week as to the existence or non-existence of any one of the above-mentioned infectious diseases in the household of every employee in his farm or dairy, who is connected in any way with the care or handling of milk. These weekly reports shall be kept on file at each creamery or milk station for a period of at least six months after their receipt and shall be always open to the inspection of the representatives of the Department of Health.”

Then follow rules for the prompt exclusion of all persons suffering from infectious disease, the final regulation being that “the failure of any creamery or milk station, farm or dairy, to comply with provisions of these resolutions may be considered sufficient cause for the exclusion of such milk or cream from the City of New York.”

During my stay in New York the Authorities in the Department of Health very kindly explained to me their methods of organisation, and, as I was anxious to see some of the actual work, attached me to inspectors serving for day and for night duty.

I was told that the number of permits which have been issued for stores in the City of New York is between twelve and thirteen thousand; and in addition to these there are 4,600 permits issued for wagons. The average daily consumption of milk in the city is estimated at 1,800,000 quarts.

An inspector took me to one of the poorest districts in the East End of New York where the inhabitants are mostly Jews. This inspector has about 700 milk shops in his district and finds that it takes about two months to make a complete round of inspection. The shops are very close together, often next door to each other, and not more than a small amount of milk is sold in each. The inspector told me that the sale is not usually less than half a can (a can contains 10 gallons) and that the average sale is about two cans a day. Formerly there used to be many small shops, mostly Italian, which sold no more than four or five quarts a day, but these have dropped out, no permits being now granted to them. On my return to the head office I was told that it was hoped to make a further reduction in the number

of shops, gradually eliminating those which now sell the smallest quantities. The shops which sell milk are general grocery stores and are frequented by people of the poorest class who usually buy provisions for not more than one meal at a time and like to get all they require at one shop. The storekeeper makes little or no profit out of his milk, but it is an important part of his business, because if he did not sell it many of his customers would go elsewhere for their other requirements. In most of the shops I visited the milk was sold "loose" *i.e.*, served out of a can; in a few, bottled milk was sold. I learnt from the inspector that the usual price for loose milk was five to six cents a quart, the price for bottled milk being eight cents.

I was interested in comparing what I saw with the conditions which prevail in a similar district in the East End of London. Shortly before I sailed from England, Dr. Manby kindly took me on a tour of inspection in a very poor district on the north side of Commercial Road, E., and we spent some hours in the quarter entirely occupied by Jews. Between the shopkeepers in this quarter of London and those whom I visited in New York there was a close resemblance. In both cities a large proportion of them belong to the lowest order of tradesmen in whom it is particularly difficult to instil elementary notions of cleanliness and sanitation. But the New York shops were certainly less filthy and less malodorous; in fact many of them were fairly clean and tidy and free from any offensive smell. The difference in the way in which the milk was kept was still more striking. Visiting about 25 New York shops in succession, I found that in all of them the loose milk was kept in the 10 gallon can in which it had been received, and that this can was covered with a closely-fitting lid. With three or four exceptions, the can was placed within a bin, also covered with a lid, and ice was placed between the wall of the bin and the wall of the can. In the exceptional cases the can was not placed in any receptacle but was standing at or outside, the shop door, apparently just as it had been left on delivery. In these cases the inspector warned the dealer that he was disobeying the regulations. In the London district which I visited the milk is kept in all sorts of receptacles, which are frequently uncovered, and no attempt is made to keep it cool. If the New York shops which I saw included samples of the worst class, which the inspector assured me was the case, they compare favourably with what is found in London. I was informed that the relatively satisfactory system in New York was the result of some years' patient work and that the original condition was quite as bad as what I described to be the present state of affairs in the East End of London. The improvement is certainly due to the knowledge that the permit will be promptly revoked if, after reasonable warning, the requirements of the Board are not satisfied.

It is sometimes thought that the permit system places in the hands of the inspectors an autocratic power which is liable to abuse. When the inspectors are officious, domineering, and

unscrupulous, this is probably the case. In New York great improvement seems to have been effected in recent years in the type of men selected for the post, and the system now appears to work well, without causing serious friction or hardship. My personal observations were necessarily very limited but, so far as they went, they gave me the impression that permits were not revoked without very good cause, *e.g.*, in the case of very stupid or very obstinate people who resolutely refused to adopt simple sanitary precautions, or when a person had been repeatedly convicted in the courts for selling adulterated milk. And the hardship of losing a permit is not so great as it might appear. What a man usually does is nominally to transfer the business to his wife or other relative; and then a fresh application for a permit is made in a new name, and, if on inspection the conditions are found satisfactory, is granted.

Further evidence that the permit system respects the principle of equal rights for all is afforded by the extremely large number of permits granted in the district which I visited. If the sale of milk were limited to shops which sold nothing but dairy products, the shops being sufficiently numerous for one to be within easy reach of every consumer, no hardship would be inflicted on the general grocery stores. They would all be treated alike, losing a business which at present brings them little or no profit and sometimes a loss, and retaining on equal terms their claims to their present customers. The customer would suffer no more than the very slight inconvenience of having to purchase in two shops instead of one; and, in compensation for this, he would be able to purchase milk kept under better conditions and better inspected. The facilities for ready, frequent, and efficient inspection would be greatly increased. It is interesting to note that New York, notwithstanding its reputation for drastic measures in the interests of public health, has not been able to institute this much needed reform. A similar reform is equally or even more needed in the East End of London; but apparently in both cities the privilege of selling milk which the grocers at present possess is regarded as inviolable.

If an inspector finds milk to be obviously "adulterated" according to the definition of this term adopted by the sanitary code, he is allowed to seize it without further ado and pour it into the sewer, no compensation being given to the owner. When an inspector takes this step he must report his action to the Board of Health, stating the amount of milk destroyed and the reason for destroying it. According to the Annual Reports of the Department of Health, 39,613 quarts of adulterated milk were destroyed in 1905 and 41,395 quarts in 1906. Most of this work of destruction is performed under the sanction of the clause which defines as "adulterated" milk found to be at a temperature of more than 50° F. In actual practice the inspector allows the dealer a margin of 5° and does not destroy the milk unless the thermometer reading is above 55° F. In justification for this destruction of milk exceeding the legal temperature it may be pointed out that even in the poorest districts of New York facilities

exist for keeping the milk cool by surrounding it with ice, and that milk properly cooled can be sold at the low price of five to six cents a quart; the importance of keeping it cool is due to the fact that the bacterial content of milk multiplies rapidly at temperatures exceeding 50° F. The dangers arising from milk not kept at a low temperature are naturally greater when the milk is 30 or 40 hours old than when it is literally "warm from the cow," but in enforcing the rule it does not seem practically possible to make allowance for this difference; consequently the New York Jews, who, like the Jews in the East End of London, prefer to consume their milk "warm from the cow," find it difficult to observe this custom. From talks which I had with inspectors I gathered that the people of New York are now well accustomed to seeing milk destroyed for exceeding the legal temperature and that the inspectors exercise this power without exciting popular indignation.

With a view to being able to trace milk back from the consumer to the source of supply, the Health Department attaches great importance to keeping full records of the farms supplying the various creameries or receiving stations and of the destinations in New York of milk sent from each of these creameries. To further the same object, they have recently (April 22nd, 1908), adopted a rule that "all containers from which milk is sold to the consumer shall bear a label or tag stating, if shipped from a creamery, the location of said creamery and the date of shipment; if shipped directly from a dairy, the location of said dairy and the date of shipment." On the day of my first visit, the Health Department happened to be dealing with a case which afforded a good practical illustration of their system. Two hours previously they had received a telegram from a doctor, 200 miles away, stating that he had a case of typhoid fever on a farm supplying a creamery which sent milk to New York. The Health Department of New York had at once notified the creamery that all milk then on its way to New York would be refused admission and that no more would be received until the supply from that particular farm had been excluded. The Department's nearest country inspector had been ordered to visit the creamery and see that these instructions were carried out; another inspector, located nearer to New York, had been ordered to visit a railway junction and warn the officials that milk from the creamery in question would not be admitted; the dealers in the city receiving milk from this source had been notified, and inspectors had been instructed to visit them and see that the supply was stopped. Finally, one of the inspectors to whom I had been attached for the purpose of seeing some night work was instructed to examine certain trains on arrival and destroy any milk he might find coming from this source. On investigation at the station we found that the milk had been stopped half way on its journey, so I was unable to witness an actual case of "dumping." If a case of typhoid fever had been diagnosed in England, under similar circumstances, how long would it have taken before the danger of disseminating the disease through the vehicle of milk could have been prevented?

A few facts may be quoted for the purpose of illustrating the work done by the City Department of Health in controlling the production and handling of milk before it arrives within the city's limits. In 1905, with the co-operation of the railroad officials of four lines on which milk is conveyed to New York City, inspectors of the Department were sent out and were given an opportunity to examine every creamery along the line at which milk was received and handled before being sent into the City. The number of creameries inspected during this year was 326. After each tour of inspection, the owners and operators of the creameries were summoned to the Chief Sanitary Inspector's office in New York; the unsanitary conditions found in the various places were brought to their notice, and the requisite recommendations for improvement were made. During the same year 176 creameries were re-inspected, some of them several times. In over 50 of these the first re-inspection showed that all the recommendations had been complied with, and at the end of the year about 125 were reported as being in an entirely satisfactory condition. Some of the creameries inspected were found in such a bad condition that it was necessary to exclude their milk from the city. During the year 1906, fifteen inspectors were employed, and 708 creameries and 11,000 farms and dairies were inspected. At the present time (1908) the Department employs 27 country inspectors in the work of examining the creameries and the farms from which these creameries receive their supply. As the number of farms supplying milk for the City is estimated at over 40,000, the task of supervision is very heavy, and an addition to the number of inspectors is considered desirable. An excellent feature in the system of inspection is the taking of photographs, which are sent to the New York office, and there collected and indexed. This collection, which was shown to me, now contains photographs of all the creameries and of a large number of the farms. Many of the places have been photographed twice, before and after the prescribed alterations have been made. When a question arises as to the sanitary condition of a particular dairy or creamery, the head inspector finds this collection of photographs a valuable aid to the verbal descriptions.

CHICAGO.

The rules framed by the Chicago Department of Health for the regulation of the milk supply are remarkably drastic.

The entrance of all "unclean" milk into the city of Chicago is forbidden, "unclean" milk being defined as "all milk produced on farms or prepared, handled or otherwise treated on the premises or in places where the rules of the Department are violated." All unclean, unwholesome or infected milk is to be condemned. "Such milk shall be returned to the producer and tagged with the 'Department Condemned' tag, and condemnation slip shall be mailed to the shipper at once; if, following this, the said producer or shipper again sends into the city

unclean, unwholesome or infected milk, the same shall be condemned and rendered unfit for human food, by coloring or otherwise treating, or shall be poured into the sewer."

It is required that the cows "must be healthy and free from tuberculosis." Milk from cows reacting to tuberculin "shall be rejected unless it shall have first been pasteurised at a temperature of 175° F. or over for 30 seconds or longer in a stream not more than a quarter of an inch thick." The department regards pasteurisation as no more than a temporary measure, and intends that tuberculosis shall be entirely eradicated from the dairy herds supplying food for the city. This, it is conceded, cannot be accomplished immediately; and therefore five years grace is allowed. The ordinance which comes into force on January 1st, 1909, prohibits the sale, under penalty of confiscation, of milk, cream, buttermilk or ice cream, "unless such milk or cream or the milk or cream contained in buttermilk or ice cream be obtained from cows that have given a satisfactory negative tuberculin test within one year; the cows having been satisfactorily tested shall be marked 'tuberculin tested' and shall be numbered and a certificate shall be filed with the division of milk inspection of the Department of Health of the City of Chicago upon forms furnished by the Commissioner of Health, giving the number, a brief description of the animal, the date of the taking of said test and the name of the owner. Said certificate shall be signed by the person making such test; provided, however, that from January 1st, 1909, for a period of five years, to wit, until January 1st, 1914, milk or cream or buttermilk and ice cream made from milk or cream, obtained from cows not tuberculin tested or not free from tuberculosis, may be sold within the City of Chicago if the milk or cream from said cows is pasteurised according to the rules and regulations of the Department of Health of the City of Chicago." Similar restrictions have been placed on the sale of butter and cheese. It is made unlawful, under penalty of confiscation, to sell in Chicago butter or cheese which does not bear upon the package either the words "Made of milk (or cream) from cows free from tuberculosis as shown by tuberculin test," or the words "Made from milk (or cream) pasteurised according to the rules and regulations of the Department of Health of the City of Chicago."

Another regulation regarding cows providing milk for Chicago may be quoted. "The feeding of slops, refuse of any distillery or brewery, glucose or any malt, or ensilage that has been subject to fermentation, putrefaction or decomposition is prohibited."

Amongst the contagious diseases which are considered of importance in relation to milk, attention is called to consumption. "Milkers and attendants in the cow stable and milk room should be free from tuberculosis." But to this is added the qualifying clause that "a consumptive can be harmless if he is intelligent and can be trusted to carry out the physician's instructions";

these words are supplemented by advice on the sanitary disposal of sputum.

Licenses have to be obtained for "milk stations," *i.e.*, places where milk is received from the country, for "milk depots," *i.e.*, places where milk is received and is prepared for distribution, and for "stores," which are defined as "all places and rooms where milk is sold, together with other foodstuffs, such as groceries, meats, bakery goods, delicatessen articles and confectionery." The annual fee charged for a license is \$10, the licenses being renewable on May 1st of each year. By a rule recently passed, "no application for license shall be approved by the Commissioner of Health after May 1st, 1908, if the records of the milk division show that the depot, store or any part of the establishment in which the business is to be conducted is in an unsanitary condition. No application for license shall be approved if applicant has a bad record. If at any time after the granting of such license the holder fails to comply with the sanitary regulations of the department, or repeatedly sells or offers for sale, or has in his possession for the purpose of selling, milk and cream below the grade prescribed by the ordinances or rules of the Department of Health, the Chief Food Inspector shall recommend to the Commissioner of Health that his license be revoked with or without further notice. Said Commissioner of Health may grant the defendant a hearing, if he deems this necessary." The temperature at which milk is stored must not exceed 50° F. Empty cans and bottles "must be cleaned and washed with hot water" before returning to the wholesale dealer or farmer. One of the latest rules, passed June 22nd, 1908, for the protection of milk runs as follows:—"No person, firm or corporation shall sell, offer for sale, expose for sale or keep with the intention of selling any milk or cream in stores or in other places where other merchandise than milk or cream is sold, unless the milk or cream is kept, offered for sale, exposed for sale, or sold in tightly closed and capped bottles or receptacles of a similar character, such as shall be approved by the Commissioner of Health of the City of Chicago."

In order to prevent the entrance into the city of milk coming from dairies which fail to comply with the sanitary requirements of the Department, an inspector is constantly employed at the receiving platforms in the city, with instructions that such milk must either be destroyed or returned to the dairies. The annual reports state that 929 eight-gallon cans were "dumped" in 1905 and 1,804 in 1906. In the years 1904, 1905 and 1906, the numbers of dairies inspected were, respectively 2,857; 3,146; and 4,029. In the report for the last of these years it is stated that "every dairy shipping milk to Chicago within a radius of 115 miles—beyond this distance no milk is shipped here because of the freight cost—is now inspected every month."

The ordinance requiring the pasteurisation of milk coming from cows not guaranteed healthy by the tuberculin test does not come into force until 1909. At the time of my visit to

Chicago (September, 1908) many of the firms in the city were arranging for pasteurising equipment and were consulting the Health Department as to the types of machinery which would meet the Department's requirement. The rapid method, *i.e.*, short exposure of the milk in a thin stream to a fairly high temperature, seemed to be the one most in favour, and at the time of my visit the Department was discussing the adoption of a standard test for the purpose of ascertaining whether pasteurisation was efficiently conducted.

The Department has taken a firm stand against the use of unwholesome material such as "wet malt" for the feeding of milch cows. In 1904 it was found that 19 per cent. of the dairies inspected were using this food; in 1905 the percentage was reduced to 8, and in 1906 only a little over 3 per cent. of the 4,029 dairies inspected were using this objectionable material. The action of the Department in enforcing its rule prohibiting the use of wet malt was vigorously resisted by powerful commercial interests; the legality of the rule was contested, and finally one offender, who had been fined by the Criminal Court, appealed, and his case was brought before the Appellate Court of Cork County. The Appeal Court upheld the decision of the lower court, on the ground that the disputed clause of the ordinance was "necessary for the preservation of the health of the people and to guard against disease."

The work in the milk inspection department seems to be conducted on excellent business principles. The report for 1905 states:—"The amount collected by the city for milk licenses was \$49,295.39; for fines, milk snits, \$8,008.00; for ice licenses, \$7,027.50; ice fines, \$98.00; revenue from condemned calves, \$621.18; making a grand total of \$65,050.50. Subtracting from this amount the total cost of running the entire laboratory, \$36,128.12, we have a net gain of \$28,922.36." The report for 1906 states:—"The income from the work in the Milk Division, in licenses and penalties, has increased from \$57,305 in 1905 to upwards of \$75,000 this year." The item "revenue from condemned calves" will not escape attention; it may cause some surprise to those who advocate compensation for such animals.

This last paragraph may be appropriately supplemented by another quotation from the report for 1906. "The Commissioner has not waited for any Pure Food Law or for the enactment and enforcement of National or State legislation, but has utilized existing resources and authority more fully than ever before."

One of the features of the laboratory work is that the general public is encouraged to make use of it in order to ascertain the quality of the milk they are buying. Thus in 1906, private individuals submitted 9,407 samples of milk and cream for analysis; 6.8 per cent. of these were found to be below the legal standard. It is found that when a customer confronts the dealer with the results of one of these analyses marked "below grade" a very salutary impression is created in the mind of the latter.

For information regarding the Chicago regulations I am greatly indebted to Dr. Evans, the Commissioner of Health, and his assistant, Dr. Biehn. My stay in Chicago was not sufficiently prolonged to enable me to form an independent opinion of the results achieved.

MINNEAPOLIS.

I visited the Board of Health of this city and had the pleasure of interviews with Dr. Hall, Commissioner of Health, and Dr. Corbett, Bacteriologist.

Every person selling milk within the city must obtain from the Commissioner of Health an annual license, which is issued free of charge and is granted on condition that the regulations of the city's "milk ordinance" are complied with. When an application to sell milk is granted the city demands the right of inspecting the source of supply. "Any such applicant, or any person from whom such applicant obtains or is to obtain his milk, shall permit the officers of the Department of Health of the City of Minneapolis to inspect the dairy and dairy herd of such applicant, or the dairy and dairy herd of the person or persons from whom the applicant obtains or is to obtain his milk, together with all appliances and milk vessels used therein, and any refusal to permit the inspection above referred to shall be deemed a sufficient ground upon which the City Council may refuse to issue the license applied for, and for such cause may revoke the same after its issue." Another condition which must be fulfilled before a license is granted is that the Commissioner of Health shall receive a certificate, signed by a licensed veterinary surgeon, stating that the cows from which the milk is to be obtained "have been by him inspected, examined and tested with tuberculin and found free from tuberculosis and other contagious diseases, and giving the results of such inspection and test as to each and every animal so examined and tested."

It is also required that dairy herds shall be tested annually, so long as the milk derived from them is sold within the city. With regard to the cost of the work the following regulation is made:—"The Department of Health of said city shall furnish all the tuberculin, stationery and tags necessary and required for making such inspection, examination and test of dairies and dairy herds, but the actual and reasonable cost of making such inspection, examination and test, not to exceed fifty cents for each animal examined and tested, and six cents per mile for each mile actually travelled by the veterinarian making such inspection in going to and returning from the place of making such inspection, shall be paid by the applicant for such license to sell milk in the City of Minneapolis and the owner of the dairy and dairy herds inspected as herein provided."

Amongst the nine definitions of "adulterated" milk established by the Milk Ordinance, the three following may be mentioned:—
(a) "Milk drawn from animals fed on distillery waste, or any

substance in a state of fermentation or putrefaction or on any unwholesome food"; (b) "Milk drawn from cows kept in a crowded or unhealthy condition, or from cows suffering with tuberculosis or any other contagious disease"; (c) "Milk, the temperature of which is higher than fifty degrees Fahrenheit, or which shall contain more than 500,000 bacteria per cubic centimeter." Milk found to be "adulterated," as defined by the Ordinance, "may be seized and destroyed by an inspector or other officer of the Department of Health of said city authorized to inspect the same."

A point of special interest in connection with the working of the Minneapolis system is that every person who sells milk within the city must possess an annual State license, in addition to his City license. This State license is granted by the Dairy and Food Commissioner of the State of Minnesota. "No person shall sell milk or cream in, or to be used in, any municipal corporation, except for the purpose of supplying the same to a butter or cheese factory, without being licensed by the Dairy and Food Commissioner, and the fee for such license shall be \$1 for each place or vehicle from which sale is made. Every such license shall expire May 1st, next after its issue." This method of double licensing enables the city to bring the State to its aid when a country producer is unsatisfactory. The city of Minneapolis, for example, can inform the State Food and Dairy Department that the milk coming from a particular farm is not in good condition; the State will then send one of its own inspectors to examine the farm; if reforms are needed on the farm, failure to carry them out will result in the Minneapolis milk-seller losing his State license, without which he cannot carry on his business.

As will be seen from the regulations for the application of the tuberculin test, the Health Department of Minneapolis is anxious to eliminate tuberculosis from the herds supplying the city. In evidence of the amount of work done in this direction it may be stated that the City Veterinary Department makes a considerable number of tests every year and condemns the animals found tuberculous. In the year 1907 this Department inspected 384 dairies and tested 8,239 cows with tuberculin; 318 of these were found to be infected with tuberculosis and were immediately removed from their respective herds, condemned and killed.

In his Report for 1907 the Commissioner of Health for Minneapolis calls attention to the fact that the death rate in children under five years of age has fallen from 7.73 deaths per 1,000 inhabitants in 1890 to 2.05 in 1907. Commenting on this evidence of improved sanitation, he remarks—"An important factor in the preservation of infant life is undoubtedly the existence of our excellent milk ordinance, which provides that milk cannot be sold in the city unless coming from cows that have been inspected and safely passed the tuberculin test." An effort is being made, Dr. Hall informed me, to induce the State to pass a measure enacting that all cattle sold within the State, not for

immediate slaughter, must be sold with a certificate of inspection and that this inspection must include an application of the tuberculin test. Such a measure would, he considered, greatly facilitate the city's efforts to eradicate tuberculosis from milk cows.

It may be worth noting that the clause in the City Ordinance which requires the application of the tuberculin test dates from 1895. Shortly after its institution, the legality of the clause was disputed, but its validity was maintained by the Supreme Court of the State of Minnesota in 1896.

OTHER LOCALITIES.

Certain features of interest in the administrative work of some of the other localities which I visited are best stated in general terms.

Whereas many cities are provided with a milk ordinance which, on paper at least, furnishes the medical officer with all the powers he could possibly desire, there are some cities which are by no means well equipped in this respect, but appear, so far as regulations go, to be hardly any better off than English towns. In cases such as these the medical officer, if enterprising enough, can contrive to exercise a good deal of authority in excess of his strictly legal rights. He makes the most of such statutes as are in force by putting a liberal interpretation on convenient ambiguities which they contain. The term "nuisance," for example, is used with much elasticity; a milk vendor who is not violating any explicit regulation affecting the sale of milk may be brought to book by the discovery that in the conduct of his business he is doing something which constitutes a "nuisance" liable to be prejudicial to the public health. And in the exercise of authority which might, if disputed, prove to be illegal, full advantage is taken of the fact that the person who wishes to resist and to invoke the aid of the law is fully aware that legal proceedings cost money and involve publicity. The small dealer cannot afford the expense, and the big dealer who is selling unwholesome milk is afraid that, though he might win his case, the publicity given in the law courts to his dirty methods would ruin his business. Naturally this policy of "bluff" has to be pursued with caution, and the health authorities do not resort to it unless they are confident that if the case came up for trial they could produce evidence which would seriously damage the offender's business.

There is also the policy of helping the strong and prosecuting the weak. Expressed in its most favourable light, this means that the big firms often desire to keep their milk up to a relatively high standard and find it commercially advantageous to do so, whilst the small traders are perhaps less enlightened and perhaps cannot afford the expense of the requisite improvements. Hence it may reasonably happen that the working criterion of

wholesome milk adopted by the local authority coincides with the criterion adopted by the wealthy firms, and an advantageous system of informal co-operation between the public officials and the business firms results; whilst the small dealer, who produces an inferior quality of milk and has no powerful interests to support him, can be successfully prosecuted with the utmost rigour of the law. This happy method of combining the interests of trade with those of hygiene is an important factor in the working of some of the American systems of milk control.

There is, however, a reverse side of the medal. When "friendly co-operation" leads to a loss of official independence, when the financial and political influence of the big firms converts the public authorities into their servants and tools, the system is rotten with corruption and is discreditable to any community which prides itself on its freedom. When a firm of milk contractors, on the eve of a presidential election, finds it prudent to contribute \$25,000 to each political party, they naturally do not intend their investment to be wasted; and the attempt of some well meaning person to prevent their distributing milk from a farm where there is a case of scarlet fever may be confronted with exceptional difficulties and delays. This is not a merely hypothetical case.

The medical officer who, whilst able to retain his office, refuses to pander to political intrigue or other unworthy influences, sometimes finds that his most unpleasant difficulties are caused by the political intrigues of important milk contractors. It is humiliating, for example, to find that in working a system where the essential control is based on the power to grant and revoke permits, a wealthy contractor can continue to sell several thousand quarts of milk a day after his permit has been revoked for very substantial cause. In a case of this sort, when he finds that it is impossible to enforce his authority, the sensible medical officer, who cares more for the public welfare than his own sense of injured dignity, finds it the best policy to say nothing about the matter, in public. He continues to enforce observance of the regulations from the less influential dealers, and devotes all his surplus energies to the education of public opinion. Nothing further can be done until the public learns the difference between good milk and bad and exhibits a preference for the former. When a general demand has been created for a better quality of milk, the task is easier; but the question of supply still requires cautious consideration. A firm doing an extensive business in many cities may be in a position to withdraw its supply from the particular city demanding reform, with the result that a shortage would be created, causing much inconvenience, an increase in prices, and a general discontent. For these misfortunes the medical officer would be held to blame, if unable to solve the difficult problem of finding good milk to replace the bad. The education of public opinion, the elimination of unwholesome milk, and its replacement by better, seem to be tasks easier of accomplishment in small cities than in large.

(3). CONCLUSIONS AND SUGGESTIONS.

In looking over the average "Milk Ordinance" of an American city one generally finds that the regulations which it contains are a mixture, capable of being roughly separated out into three types :—(1) rules which are obviously necessary and are generally enforced in most communities ; (2) rules which are excellent in principle but of more or less doubtful applicability in practice : and (3) rules which, whether desirable or not in theory, cannot possibly be enforced under existing conditions.

Many of the American codes are framed in too aggressive a spirit. The intention is good : they are promulgated simply and solely with a view to advancing the interests of public health, and these interests rightly claim precedence over other and merely commercial considerations. But the requirements of the consumer would be better served if it were made more clear that due regard was also being paid to the actual conditions and difficulties of production. American experience shows that regulations demanding more than the actual producer can reasonably perform are worse than useless ; they are always evaded and satisfy nobody ; by disappointing the consumer and exciting the hostility of the producer they retard the work of milk reform instead of advancing it. *Aggressive programmes of milk reform have not succeeded in America and are not to be recommended.*

At the same time it is important to recognise that American methods, at least in those instances where they are now working well, are not, in practice, of the aggressive character which they may appear to present on paper. And for two excellent reasons ; the medical officer has no desire to inflict hardships on the milk trade ; and, if he made the attempt, the American public would not tolerate it for a moment. Such requirements of the code as are found to be unreasonable are, as a matter of fact, not enforced. With perhaps one exception, *viz.*, the "dumping" of milk found to be at a temperature over 55° F., the treatment accorded in America to the dealer or dairyman not guilty of some flagrant abuse is usually most lenient. Drastic steps, such as the revocation of a permit or the permanent exclusion of milk from a city's supply are only taken when the offender refuses, after repeated warnings, to obey the most elementary principles of hygiene. The mere knowledge that the authorities possess these powers and actually can exercise them, if necessary, is sufficient ; it provides the requisite argument to convince the offender that he must make such improvements as lie within his power. More than this the authorities do not expect or require. *Actual reforms are mainly due to the acceptance of reasonable recommendations offered by the Medical Officer, and are attributable to the recognition rather than to the exercise of this Officer's right of direct intervention.*

In considering the value of the "permit" system, it is essential to take into account the difference, frankly admitted by

the Americans themselves, between paper regulations and regulations actually enforced. Theoretically, a permit is only issued to such persons as satisfy the medical officer that they are capable of complying with the city's regulations, and is cancelled by the officer's own authority if any of these regulations are violated. If one takes the text of a municipal milk code as it actually stands, and asks, is it possible or reasonable to restrict the milk trade to persons who comply with all these conditions? the answer must undoubtedly be in the negative. It is obvious that the officer cannot insist on implicit obedience to all the rules. He must necessarily make a selection, and decide for himself what are the actual rules upon obedience to which the tenure of a permit shall in fact depend. This introduces an element of arbitrary choice, and affords ground for the objection that the right to deal in milk should not be made dependent on the personal opinion and judgment of one man. *The theoretical right of the medical officer to withhold or revoke a permit for any and every breach of the municipal regulations may be questionable.*

But in actual practice the medical officer cannot revoke or withhold a permit except for persistent refusal to conform to those regulations which are admitted by all except the most unscrupulous members of the milk trade to be just and reasonable, *i.e.*, rules requiring that milk shall not be kept or produced under obviously unsanitary conditions and that it shall not be adulterated by the abstraction of cream, the addition of water, or the introduction of preservatives. The medical officer, to quote the words of the Supreme Court of the United States, does not in fact exceed "a fair and reasonable exercise of that discretion which the law reposes in the Board of Health" for the purposes of controlling a business "which, unless controlled, may be highly dangerous to the health of the community." *In practice the permit system works well and involves no hardships or injustice to the honest dealer.*

Assuming that the powers conferred by the permit system are only exercised in a just and temperate manner, the question may be raised whether the evils which this system is intended to correct could not be dealt with equally well by prosecuting actual offenders in the courts. Theoretically, perhaps; but practically, no. When a man proves himself by his conduct, his temperament, and his surroundings to be a person who cannot be safely entrusted with the care of milk, the imposition of fines will never reform him. Apart from the fact that fines for adulteration are usually paid for him by the man from whom he obtains his milk, the only way which proves effective in dealing with these people is to make it plain to them that if they cannot sell milk in accordance with the minimum requirements of the law they cannot sell it at all. *The direct control exercised by the permit system is an effective instrument of reform; prosecutions in the law courts are not.*

Closely connected with the permit system is the right of imposing conditions which must be fulfilled before milk can be permitted to enter the city. Here again one must distinguish

between theoretical rights and rights actually enforced. If milk were excluded merely because it came from a dairy unable to conform to some ideal standard of dairy perfection which happened to be placed in the "ordinances," the right of exclusion would undoubtedly be exercised in an arbitrary and unjustifiable manner. But it is well-known, and the trade is not prepared to deny, that some dairies are so abominable that they are a disgrace to the agricultural interests as well as a danger to human health. The exclusion of milk from places such as these is obviously reasonable. It is all a question of where to draw the line. *The exclusion from a city of milk which is not provided with a reasonable guarantee that it has been produced under wholesome conditions is justifiable.*

The objections to the American system of controlling the milk trade by means of "permits" and by prohibiting the sale, within the area of the local authority, of milk not produced under certain conditions, would disappear if the right entrusted to the local medical authorities were defined with sufficient precision to make it impossible for such powers to be exercised arbitrarily or to the detriment of legitimate trade interests. In America perhaps this objection cannot be easily overcome, because the people have an affection for rules embellished with vigorous ideals of what ought to be, and therefore they are compelled to uphold the theory that their medical officer is vested with the power of enforcing the regulations *en bloc*. But in other countries there seems to be no reason why this obstacle should arise, and it ought to be possible to secure the advantages of the American system without its defects. There seems, for example, nothing unreasonable in demanding that a standard of efficient veterinary and sanitary inspection should be established, and that milk should not be accepted at the railway stations unless it came from farms which had passed this standard. *It would be an advantage to entrust to the local health authorities reasonable and legally defined powers of direct control over the production and sale of milk.*

B. SPECIAL ASPECTS OF THE MILK PROBLEM.

(1.) PASTEURISED MILK.

The theoretical aspects of the question whether milk ought to be pasteurised are largely discussed in America; but it seems advantageous in dealing with this subject to consider what actually is being done before entering into theories.

In all the large cities which I visited I found that the custom of pasteurising milk is common, particularly amongst the large dealers. In Minneapolis I was told that about 40 per cent. of the city's supply is pasteurised; in New York the percentage is said to be 25 and in Philadelphia 75. Boston, in 1906, received 368,849 quarts of milk daily, and of these, 123,250 quarts were pasteurised.

Dealers pasteurise their milk in order to make it keep longer. This is the main and generally the only reason. Some of them may be also influenced by the knowledge that the germs of infectious diseases are liable to be conveyed by raw milk, and that their presence, if detected or suspected, is likely to cause trouble. In some cities, for example, the health authorities keep careful records of the number of cases of infectious disease which occur amongst each dealer's customers. If a particular dealer happens to have a heavy score against him, an inquiry is instituted which may cause serious interference with that dealer's trade. So pasteurisation is employed as a commercial safeguard, to prevent loss from sour milk or from the interference of the health officer.

The methods of pasteurisation vary. In Washington I visited an excellent firm, where the milk is heated to 148° F. and by an automatic arrangement is held at that temperature for half an hour before being discharged into the cooling apparatus. But in many places very much less care is taken about exposing the milk to an adequate temperature for a proper length of time. Pasteurisation by "the rapid method" is popular, the principle of this system being to cause the milk to flow in a thin stream exposed for a brief period to a fairly high temperature. In an apparatus of this kind which I saw at Washington the milk flowed between an outer and an inner metal coil heated with water to 185° F., and was exposed to this temperature for one minute. The milk inspector of Boston says "commercial pasteurisation means the heating of milk to varying temperatures, usually from 155° to 170° F., for a short time, usually a matter of seconds, and then suddenly cooling. . . . Oftentimes this pasteurisation means that filthy milk which would under ordinary conditions be unsaleable, because of souring, is given a new lease of life and becomes a marketable commodity."

The first mentioned Washington firm, though working as a purely business concern and showing a reasonable profit, conducts its pasteurising under ideal conditions. The work is under the constant supervision of a bacteriologist who makes bacterial

counts of the milk as it is received and during each stage of the pasteurising process down to the final bottling. He also inspects the cleaning of the apparatus and makes cultures from any part of the machinery which he suspects have not been adequately cleansed. The workmen appreciate this control and take a pride in getting good results as judged by the bacterial test. The milk purchased by the firm is the best procurable from the Washington district and is by no means "filthy," but the firm considers that it is commercially advantageous to resort to efficient pasteurisation in order to bring about a large reduction in the bacterial count and to eliminate any pathogenic bacteria which possibly may be present.

As examples of pasteurising in Philadelphia, some of them less satisfactory than the above, I quote the following cases investigated by Drs. Pennington and McClintock:—

I.

Material examined.	Count per c.c.	Twenty-four hours later, count per c.c.
Milk from first tank	1,504,000	25,380,000
" " second tank	2,250,000	37,800,000
" " Pasteurising coil, 155° F. ...	18,000	360,000
" " first cooling coil, 75° F. ...	33,000	1,020,000
" " second cooling coil, 64° F. ...	2,160,000	3,780,000
" after bottling, ready for consumer ...	2,880,000	45,900,000

II.

Material examined.	Count per c.c.	Twenty-four hours later, count per c.c.
Milk from original can	42,666	300,000
" " first tank	340,000	700,000
" " second tank	620,000	3,420,000
" " Pasteurising coil, 158-160° F. ...	16,800	240,000
" " first cooling coil, 78° F. ...	19,666	420,000
" " second cooling coil, 34° F. ...	178,666	1,560,000
" bottled, ready for consumer	446,000	2,880,000

III.

Material examined.	Count per c.c.	Twenty-four hours later, count per c.c.
Milk from first reservoir	1,140,000	4,456,000
" " second tank	2,100,000	4,860,000
" " first Pasteurising coil, 160° F. ...	1,000	1,266
" " second coil, 70° F.	1,933	3,166
" " third coil, 42° F.	63,666	88,666
" " pipe entering bottling tank ...	86,000	360,000
" bottled, ready for consumer	138,000	3,280,000

IV.

Material examined.	Count per c.c.	Twenty-four hours later count per c.c.
Milk before placing in tank	7,680,000	13,800,000
" after placing in tank	7,140,000	12,600,000
" after leaving cooling tank	3,000	6,000
" from pipe to bottling tank	3,333	6,000
" ready for the consumer	744,000	785,000

I and II, where the milk was in a worse condition at the end of pasteurisation than at the beginning, afford excellent examples of dirty machinery. In III and IV the bacterial content shows a numerical reduction, but the diminution in III is only slight at the end of 24 hours. In IV, though the number of living bacteria has been greatly reduced, the initial count was very high and the undesirable and probably unwholesome material associated with this bacterial content would still be present after pasteurisation.

From the Boston Milk Inspector's Report for the year 1907-8. I quote the following statistics bearing on the same subject.

BACTERIOLOGICAL EXAMINATION OF PASTEURISED MILK FROM STORES.

Bacteria per cubic centimetre.	Number of Samples.	Percentage.
Under 50,000	3	4.12
50,000 to 100,000	7	9.59
100,000 to 200,000	1	1.36
200,000 to 300,000	3	4.11
300,000 to 400,000	5	6.85
400,000 to 500,000	6	8.22
Total samples under 500,000	25	34.25
500,000 to 600,000	5	6.85
600,000 to 1,000,000	13	17.82
1,000,000 to 3,000,000	25	34.24
3,000,000 to 5,000,000	3	4.12
Above 10,000,000	2	2.72
Total samples above 500,000	48	65.75
Total	73	100.00

The bacteriological data which I have quoted are sufficient to show that pasteurisation, as a commercial process, is conducted with varying degrees of inadequacy or adequacy. From inquiries made in various cities I formed the general opinion that if the firms were grouped, according to their manner of conducting this business, into the three classes of (1) good, (2)

bad, and (3) indifferent, the majority, probably a large majority, would come under (2), and there would be many more in group (3) than in group (1).

Some reformers consider that pasteurisation is radically bad in principle, and strongly disapprove of it. But is it possible to obtain and enforce a law prohibiting firms from resorting to this process? The answer seems to be definitely, No. It has taken a strong hold on the trade; trade interests are very powerful and the effective influence of the reformers who dislike the process is relatively slight; it is necessary to recognise that, as a matter of fact, the abolition of pasteurisation is impossible.

More importance attaches to proposals which, recognising conditions as they are, aim at improving the way in which the business is at present being conducted. The best effort towards practical reform which I have been able to discover comes from the City of New York. On April 22nd, 1908, the following rules were added to their Sanitary Code.

"1. Pasteurisation of milk must be carried out under a permit therefor issued by the Board of Health, in addition to the usual permit for milk required by Section 56 of the Sanitary Code. 2. The milk after pasteurisation must be at once cooled and placed in sterilised containers, and the containers sealed. 3. All pasteurised milk must be delivered to the consumer in sealed containers which are plainly labelled 'pasteurised.' The labels must also bear the date and hour when the pasteurisation of the milk was completed, the degree of the heat employed, the length of time exposed to the heat, and the number of the pasteurisation permit issued by the Board of Health. 4. Pasteurised milk must be delivered to the consumer within twenty-four hours of the pasteurisation. 5. No milk shall be pasteurised a second time." The value of these regulations must be judged by their results, and as they had not been in force for more than a few months when I visited New York, it was not possible for me to form an opinion as to their actual working.

In the interests of the producer, as well as in those of the consumer, the principle that pasteurisation should be subject to official inspection seems to be excellent. The best class of firm, as I know from personal observations and inquiries both in Washington and in London, obtains the best milk procurable at the ordinary trade rates and does not resort to pasteurisation as a means of "doctoring" inferior and cheaper stuff; these firms recognise the importance of conducting the process thoroughly and of keeping their machinery clean; their milk is delivered to the consumer well within twenty-four hours after pasteurisation, and they do not distribute milk which has been pasteurised a second time. Such firms have nothing to fear from official inspection governed by rules framed according to the reasonable requirements of the trade, whereas they would indirectly benefit from the application of similar inspection to the inferior firms whose methods are unreliable, dirty and unscrupulous. With one exception, the requirement that all pasteurised milk must be

delivered to the consumer in sealed containers, the New York rules seem capable of application to other communities without the infliction of hardship or injustice upon legitimate trade interests; and as the consumer may properly ask to be protected against the dangers of stale pasteurised milk or of milk passed through such dirty machinery as to become richer in bacteria at the end of the end of the process than it was in the beginning, official intervention with a view to the prevention of such practices ought to meet with general approval.

There are many American authorities who advocate compulsory pasteurisation, not because they think pasteurised milk is better than clean raw milk, but because they consider that the bulk of raw milk, as at present produced, is liable to contain pathogenic bacteria. Is it possible to establish compulsory pasteurisation? In legislating for swine this actually has been done. It is the custom in Minnesota for the farmers to send their milk to factories where the cream is removed and the skim milk returned to them for the purpose of feeding their pigs. It was found that the milk frequently contained tubercle bacilli which set up tuberculosis in the pigs and gave rise to a serious economic loss; consequently a law has been passed requiring the pasteurisation of all factory skim milk. This law has been in effect for several years and has given general satisfaction. But the State is unable to pass a law preventing the feeding of babies with milk containing, or likely to contain, living tubercle bacilli. The reasons why pigs are better protected by the legislature than children appear to be—(1) pigs have a definite market value, and it is recognised that economic interests must be protected; (2) the need for legislation to protect the health of human beings is less well established; (3) the agricultural interest carries votes at an election; (4) public health interests carry little or no political weight. Pigs in Minnesota are better protected than in some of the other States, but, so far as my experience goes, it is true of all the States which I visited that, for the purpose of effective legislation, economic considerations outweigh considerations of human health. It seems that those who advocate compulsory pasteurisation of milk intended for human food must acquire more influence than they at present possess before they can carry their point, even if their views be accepted as sound.

Since it appears impossible, at least under present conditions, either to abolish pasteurisation or to establish compulsory pasteurisation for all milk intended as human food, it does not seem of interest, in connection with this Report, to recapitulate the arguments employed for and against this process. From what I have observed in America, where the pasteurisers and anti-pasteurisers are about equally divided, the more immediate object of reform should be to give both sides a better opportunity of propagating their views than they possess at present. This could be accomplished by compelling the dealer to sell all pasteurised milk as such. The customer would then know

whether he was getting pasteurised milk or raw milk ; he would be able to weigh for himself the arguments of the pasteurisers against those of the anti-pasteurisers, and would select his milkman in accordance with the opinion which he formed.

Commercial pasteurisation is firmly established and cannot be abolished ; but it seems both possible and desirable to institute a system of inspection which shall provide a guarantee that the work is done efficiently, with regard to the interests of the consumer and in accordance with the standard of skill, care, and cleanliness already observed by the better class of firms.

Whilst official encouragement or enforcement of pasteurisation might be objectionable, it would appear useful and reasonable to insist that pasteurised milk shall be sold as such, in order to enable the consumer to choose for himself between the pasteurised and the raw article.

(2). BACTERIAL STANDARDS.

Before discussing technical details I propose to give an example of a bacterial standard which is really useful. At Washington I visited a firm, conducted on strictly business lines, which employs a bacteriologist to examine the milk from every farm with which the company deals. Culture plates representing the bacterial growth of milk derived from each of the farms are fixed with formalin and kept for reference. Fresh cultures of each milk supply are made periodically and the later results are compared with the earlier. Sample cultures are arranged on shelves in the office, with the farmers' names attached to them. When a culture shows an excessive number of bacteria, the farmer concerned is asked to call at the office ; the masses of white specks on the culture plate are pointed out to him and he is told that they mean dirty milking. As examples of clean or relatively clean milking, he is shown culture plates, prepared with milk from other farms, where the white specks are obviously much less numerous. He is told that what is accomplished on other farms ought to be accomplished on his, and that if it is not his contract will not be renewed. The ordinary requirements of cleanliness are discussed and practical suggestions for improvement are made. With the exercise of patience and the repetition of this warning, when necessary, the desired object is generally attained ; when it is found impossible to effect any improvement, as indicated by the bacterial standard, the contractor ceases to do business with the farm in question. This firm's "bacterial standard" is not a certain number of bacteria per cubic centimetre ; it is a row of culture plates, arranged on shelves, with the farmers' names attached to them. It is a standard adopted for trade purposes and works well.

As additional examples of firms which appreciate bacterial standards, I quote the following from the Boston Milk Inspector's Report for 1907-8. "During the year the various contracting firms made 29,208 bacteriological examinations of milk in the endeavour to ascertain the quality of their supplies. Of this

number, 928, or 3.17 per cent., were classified as containing pus or streptococci. Where the milk was found to have a high bacterial content, notices stating that fact were sent to producers, and the latter were also notified of the necessity of having their milk comply with the requirements of the Board of Health. One concern sends notices to farmers where the numbers of bacteria reach 250,000 per cubic centimetre, and all milk found by this firm to have above 100,000 bacteria per cubic centimetre is pasteurised and used for cream and butter. In instances where pus and streptococci were present in milk, the progressive concerns procure samples from the individual cows in each herd, and in this manner locate the cause of the trouble. The milk from the cows at fault is withheld until such time as the milk appears normal. . . . All of the contracting firms agree that the bacteriological work of the last three years in connection with the milk supply has resulted in a marked improvement. One firm states that the amount of sour milk has been reduced 70 per cent."

The above examples serve to show that bacteriological standards are useful, when properly applied, and advantageous to the trade as well as to the consumer.

Various local authorities have attempted to establish a numerical bacterial standard for ordinary market milk.

According to the latest copy of the Chicago rules (April 13th, 1908), "milk on arrival in the city must not contain more than 1,000,000 bacteria per cubic centimetre from May 1st to September 30th, and not over 500,000 bacteria per cubic centimetre between October 1st to April 30th. Milk for delivery to the consumer shall not contain an excessive number of bacteria. The sale of milk containing over 3,000,000 bacteria per cubic centimetre is prohibited, and the dealer selling or offering for sale such milk shall, after three examinations of his milk on successive days by the bacteriologist and showing bacterial counts above 3,000,000, be prohibited from selling milk until the method of production and handling of his milk supply has been properly regulated by the department."

New York, in 1900, attempted to establish a bacterial standard of 1,000,000.

In Minneapolis and in Boston the legal standard is 500,000. In Montclair, New Jersey, the standard is 100,000.

Dr. Goler, the Health Officer of Rochester, New York State, says "for several years we have endeavoured to insist upon a municipal standard of 100,000 bacteria per c.c. No ordinance provides for this standard, nor do we attempt, save through notifications, to punish the vendor who submits a sample containing a greater number of bacteria per c.c. If a sample contains over 500,000 bacteria, we send the man a notice warning him that his licence will be revoked if he again has such a large count. If such a number is found on a subsequent examination, the licence is revoked as a still further warning, though he is permitted to renew it if he promises to pursue more cleanly methods."

Some of these bacterial standards look excellent, on paper ; but are they really enforced ? My experience in America leads me to believe that they are not ; and in several instances I found that the efforts which had at first been made to enforce them had failed, and that further attempts to prosecute dealers or revoke their licences, on the ground that they had exceeded the limit imposed by the bacterial standard, had been abandoned. This was almost to be expected, owing to the obvious difficulties of enforcing the standard. In illustration of these difficulties I quote a few of the statistics which have been collected by Dr. Rosenau, Director of the Hygienic Laboratory at Washington. In his own laboratory an extensive investigation has been made of the Washington milk during the summer months of the years 1906 and 1907. In 1906 the average number of bacteria per c.c. was found to be 22,134,000 ; in 1907 it was 11,270,000. Amongst the investigations of other observers, quoted by Rosenau, I note the following :—Bergey, in 1904, reported the average bacterial content of milk in certain American cities as follows :—

	Bacteria per c.c.			
New York	4,000,000
Boston	2,300,000
Chicago	2,350,000
Baltimore	4,000,000
Wilmington	7,000,000

In the same year Jordan found that the market milk of Chicago contained an average of 9,361,000 bacteria per c.c. in April, 10,071,000 in May, and 18,924,000 in June ; sixteen per cent. of the samples contained over 20 million bacteria per c.c. Byrnes, also in 1904, found that in the milk supply of Philadelphia the bacteria per c.c. varied from 1,600 to 21,000,000. The results of investigations made in Europe show that in most European towns the bacterial content of milk is quite as high as in American cities, or even higher.

In considering these statistics too much stress must not be laid on the precise figures quoted, because different investigators employed different methods of working and their results are not strictly comparable. The main point is that, where the ordinary city milk contains as a matter of fact several million bacteria per c.c., the bacterial standards laid down in some of the American ordinances are not likely to be enforced.

It would, however, be a serious mistake to suppose that the American bacterial standards are useless. Against the medical officer who finds himself unable to enforce direct compliance with his city's "bacterial standard" it is easy to direct obvious criticisms of an adverse nature ; but it is more useful to appreciate the fact that, in spite of this disadvantage, the information obtained by bacteriological examinations is of great value to him as a guide to the control of the milk supply, and has already been turned to excellent account. The practical importance of the work is well put by Rosenau. "The activities of our health

officers were at first directed almost exclusively to the prevention of sophistication of milk, detected by chemical methods, to the neglect of the valuable information obtained from bacterial examinations. The addition of water to milk and the extraction of cream are fraudulent practices, but, as a rule, have only a secondary bearing upon the public health. The bacteriological examination of milk gives us a clue to the cleanliness of the methods employed, the temperature, and the age of the milk. The health officer who has the advantage of bacteriological assistance knows that the milk of dairies containing excessive numbers of bacteria is dirty, old, or warm. With a bacteriological count as a guide it is comparatively easy to determine the cause of the trouble and to institute proper means to correct it. The enumeration of bacteria in milk is, therefore, one of the readiest and cheapest methods at the disposal of health officers to determine the general sanitary quality of the market milk supply. The laboratory results serve not only as a guide to direct the efforts of the health officer, but confirm the conclusions arrived at from an inspection of the dairies and dairy farms." I consider that Rosenau's statements are fully justified by what has already been accomplished in America.

The bacteriological work done in Boston by the health authorities affords a good example. The following tables, which I obtained from Dr. Rickards, Director of the Bacteriological Laboratory, illustrate the nature and extent of the routine milk investigations.

BACTERIOLOGICAL EXAMINATIONS OF BOSTON MILK IN 1907.

Total number of samples examined	4,681
No. of samples showing over 500,000 bacteria per c.c....	1,307= 28
No. of samples passed by microscopic method alone	1,404= 30
No. of samples showing presence of pus	16=0.34%
No. of samples showing streptococci	35=0.75%
No. of samples showing both strepto- cocci and pus	1

BACTERIAL CONTENT OF BOSTON MILK IN 1907.

Where obtained.	Number of Samples.	Percentage of counts above 500,000 per c.c.
Contractors	2,947	17
Wagons	978	39
Stores	643	59
Unclassified	113	31

Philadelphia is another city where great importance is attached to bacteriological investigations of a practical nature. The Health Officer, Dr. Abbott, and his assistants kindly explained their methods to me. Special importance is attached to the microscopical examination of the deposit after centrifugalisation. In 1904, for instance, 9,821 samples of milk were bacteriologically examined; 1,219 of these were condemned; 292 contained pus; 254 contained pus organisms; and 673 contained both pus and pus organisms. Veterinarians, sent to inspect the herds from which the condemned samples came, reported as follows:—

Conditions and diseases reported.	Number of reports received from veterinarians.
Mastitis	383
Septicemia	1
Pustular dermatitis	5
Cowpox	4
Parturient paresis	1
Milking too close to parturition	17
Out of condition	2
Total number of abnormal conditions	413
Number of cases where no disease could be detected	103
Total number of cases examined	516

The same report also states:—"The later reports received by the chief milk inspector, Mr. Clegg, from the veterinarians called to inspect the herds when milk has been condemned, are as follows:—Per cent. of inspection in which disease was found when milk was condemned because it contained pus, 97·1. Per cent. of inspection in which disease was found when milk was condemned because it contained pus-producing organisms, 74·3. Per cent. of inspections in which disease was found when milk contained both pus and pus-producing organisms, 90·3." In Philadelphia, Dr. Abbott informed me, bacterial counts have been abandoned, and reliance is placed solely on the microscopic examination of the deposit.

In New York City, Dr. Park, who makes the bacteriological examinations for the Board of Health, informed me that he makes 100 bacterial counts per week of milk samples taken from the railway platforms and the cans or bottles in stores and wagons. He finds the counts are useful as an indication of dirtiness or high temperature, and time of keeping. Since the rule that the temperature of milk must not exceed 50° F. has been enforced, there has been a marked diminution in the figures yielded by the summer bacterial counts. In former times these often gave from 40 to 500 million bacteria per c.c.; now, the worst counts are generally under 10 million.

In many parts of the United States which I visited I was strongly advised to study the work done by Dr. Goler, Health Officer of Rochester, N.Y., in improving the milk supply. When I visited Rochester, Dr. Goler informed me that the city contains 200,000 inhabitants and uses 70,000 quarts of milk daily. Every year, bacterial counts of 1,000 samples are made: fifty per cent. of these now yield less than 100,000 bacteria per c.c. There are 170 retailers in the city, and counts of the milk from each of these are made at least four times in the course of the year. The yearly cost of the milk work in Rochester is \$6,000. This sum includes the salaries of the bacteriologist and chemist and three inspectors, together with the salaries and travelling expenses of six nurses who are employed for eight weeks for work at the summer municipal milk stations. Dr. Goler is a strong believer in the value of the bacterial count, and considers that the reduction which he has effected in the bacterial content of Rochester milk is one of the causes which have brought about a diminution of infantile mortality. The work commenced in 1900, when the systematic collection of samples to determine the bacterial content of milk was instituted.

The above data are sufficient to show that bacteriological knowledge actually is being applied to the control of the milk supply with good results. The routine work of preparing and counting culture plates and examining microscopic preparations is neither costly nor difficult. To prepare and count a culture obviously takes much longer than to examine a film, and as it is desirable to make as many examinations as possible and to do them as rapidly as possible, it is interesting to find that in some cities, *e.g.*, Boston and Philadelphia, much useful information is obtained by the microscopic examination alone. In Philadelphia they rely on this method entirely; in Boston a film is examined first and only the suspicious samples are plated.

Special attention may be called to the fact that microscopic examination, in addition to affording evidence of the relative abundance of bacteria (*i.e.*, evidence that the milk has been handled or produced in a dirty way, or is old, or has been exposed to an unduly high temperature) sometimes gives a useful indication that the animal yielding the milk is actually diseased, the microscopic diagnosis being confirmed by subsequent veterinary examination. I quote an example of the prompt efficacy of this method from one of the Philadelphia reports. "Recently a child was made sick by the use of milk, the sample, which was sent to the laboratory, was found to contain pus and streptococci in large numbers. The dairyman was notified, his herd inspected, and the infected cows excluded within six hours."

The results already obtained in America by the use of bacteriological methods are worthy of admiration. Much more remains to be done towards perfecting these methods, and, in particular, the practical problems of differentiating pathogenic from non-pathogenic bacteria present in milk are still far from

being solved; they offer a wide and important field for future inquiry.

Routine bacteriological examinations of samples, for the guidance of the milk inspection service, are valuable, and should be adopted. They afford the most reliable, the cheapest, and often the quickest means of discovering when milk has been improperly handled.

Upon the pathogenic effects of many of the bacteria commonly present in milk further research is needed.

(3.) THE COOLING OF MILK.

Closely allied with the questions of bacterial standards is the problem of temperature, since it is known that temperatures above 50°F. favour the rapid multiplication of the majority of bacteria present. In America great stress is laid on this factor, and most of the cities which I visited have an ordinance, reasonably well enforced, prohibiting the sale of milk found to be at a higher temperature than 50°F.

In the following respects American conditions are different from those which obtain in England. (1) It is the general custom to collect ice in winter and store it in ice-houses; and the winters are so severe that the ice produced and readily obtainable is sufficient to last through even the hottest summer. (2) The summers are so hot that the use of ice is absolutely necessary to protect many of the more perishable foods; the addition of milk to this number therefore does not appear to the people to be an unreasonable or remarkable innovation. (3) In the case of many of the larger cities the time occupied in transferring the greater part of the milk from the farm to the city contractor, and thence to the consumer, is much longer than in England; and as the dealer cannot sell milk unless it keeps sweet, the use of ice is often a matter of commercial necessity. (4) The American habit of demanding iced drinks makes it natural for them to expect that milk shall be treated, as far as possible, like other liquids intended for consumption.

For these reasons the health authorities have had a relatively easy, or at least a reasonable possible, task in keeping down the temperature of milk during the summer months. They have had to fight for it: compelling railway companies to put on refrigerator cars, and enforcing the use of ice at other stages during transit and storage are matters which cannot be accomplished without a struggle. And much still remains to be done. In Washington, for example, Rosenau gives the average temperature of milk during the summer of 1906 as 16·5°C. (61·7°F.); in 1907 the average was brought down to 14·2°C. (57·6°F.), a great improvement, but still short of the ideal. And in other cities I have found, by examining the records which inspectors have kindly shown to me, that summer temperatures of 60°F. and over are very common indeed. Nevertheless, taking the results

as a whole, there is substantial evidence that America has already made solid progress towards reducing milk temperatures, and is evidently gaining ground year by year.

In England some of the main obstacles are :—(1) the cost of ice, which in America, I was told, can be manufactured at from 75 cents to one dollar per ton ; (2) the absence of effective demand for cool milk ; (3) the objection of the railway companies to provide suitable vans ; (4) the difficulty of obtaining ice at the farms. At present (2) seems to be the most serious of these difficulties. If the better class consumer, who ought to know the advantages of properly cooled milk in hot weather and can well afford to pay a little extra for it, would insist on demanding it, the problem would at once become a suitable matter for practical discussion.

At present it seems impossible to compel English milk-sellers to keep milk at a temperature not exceeding 50° F. in hot weather.

(4.) TRADE STANDARDS FOR MILK VALUES.

Though it is impossible to make all marketable milk good by Act of Parliament, it is both possible and desirable to obtain wider recognition, from producer and consumer alike, that the value of milk ought to depend upon its quality.

In the latest amendments (April 22nd, 1908) to their Sanitary Code, the Board of Health of the City of New York is endeavouring to establish this principle. Milk is graded as follows :—(1) “Milk,” *i.e.*, cows’ milk which conforms to the ordinary requirements of the code. (2) “Selected” or “inspected” milk. The minimum requirements for milk so designated are :—“1. Only such cows shall be admitted to the herd as are free from all diseases of the udder, and from clinically manifest tuberculosis. 2. That all the cows be examined clinically each year by a veterinarian of the Department of Health ; all cows with any disease of the udder, or with clinically manifest tuberculosis, to be excluded from the herd and farm. It shall be unlawful to sell or use the milk from such cows for food purposes. 3. That the milk shall never contain more than 60,000 germs per c.c. in winter, nor more than 100,000 germs per c.c. in summer. 4. That such milk be delivered to the consumer only in sealed bottles, which shall have been filled at the dairy or creamery and shall be labelled with the date of the earliest milking whose milk forms part of the contents of the bottle. 5. That such milk be delivered to the consumer within thirty-six hours after milking.” (3) “Guaranteed” or “certified” milk. The minimum requirements for this are :—“1. That only such cows be admitted to the herd as have not reacted to a diagnostic injection of tuberculin. 2. That all cows be tested annually with tuberculin, and all reacting animals be excluded from the herd. 3. That the milk shall not contain more than 30,000 germs per c.c. when delivered to the consumer. 4. That the milk be delivered to the consumer

only in sealed bottles which shall have been filled at the dairy, and shall bear a label giving the name of the dairy, and the date of the earliest milking at which the milk forming part of the contents was drawn. 5. That such milk be delivered to the consumer within thirty-six hours." (4) "Pasteurised" milk. The regulations for this class of milk have been quoted above.

In 1907 a conference appointed by the Commissioners of the District of Columbia recommended that three grades of milk should be recognised by law, *viz.*, (1) certified milk, (2) inspected milk, and (3) pasteurised milk. The requirements specified for (1) may be summarised briefly as ideal conditions, including a maximum count of 10,000 bacteria per c.c., and delivery to the consumer within 12 hours. (2) "Inspected milk" is to be "clean raw milk from healthy cows, as determined by the tuberculin test and physical examination by a qualified veterinary surgeon." (3) is to be "milk from the dairies not able to comply with the requirements specified for the production of milk of classes 1 and 2"; it is to be pasteurised before being sold, and must be sold under the designation "pasteurised milk." Before being pasteurised it "shall be kept at all times at a temperature not exceeding 60° F."; and after pasteurising it "shall be placed in sterilised containers and delivered to the consumer at a temperature not exceeding 50° F." The recommendation also requires that "all milk of an unknown origin shall be placed in class 3 and subjected to clarification and pasteurisation." Cows "in any way unfit for the production of milk for use by man, as determined upon physical examination by an authorised veterinarian" are not to be permitted to produce milk even for class (3), but cows which have reacted to tuberculin but do not show physical signs of tuberculosis may be used for milk of this class. Pasteurising is defined as "the heating of milk to a temperature of 150° F. or 65° C. for 20 minutes, or 160° F. or 70° C. for 10 minutes, as soon as practicable after milking, in inclosed vessels, preferably the final containers, and after such heating immediate cooling to a temperature not exceeding 50° F. or 10° C. The pasteurising plant must be "under the personal supervision of an officer or officers of the Health Department."

It will be observed that the Washington recommendations are of a distinctly coercive character. All dealers not able to conform to the high standards of classes 1 and 2 are to be compelled to pasteurise, under official supervision. Whether or no such stringent requirements can be enforced must depend upon local conditions. In England, at the present day, such drastic proposals hardly seem likely to meet with acceptance.

The New York regulations, on the other hand, do not interfere with ordinary raw market milk, and therefore the dealers in this commodity cannot complain of any hardship. But unless the dealer conforms to special requirements he is prohibited from misleading his customers by the use of fancy terms such as "guaranteed," "selected," &c. This regulation has been made

in order to protect the firms which are doing genuine business in the better qualities of milk. This certainly seems a step in the right direction, and, I was informed at the Board of Health, these requirements are being actively enforced.

In view of the arbitrary and misleading application to milk sold in this country of such terms as "pure," "nursery," "medically inspected," "from tuberculin tested cows," and the like, it seems desirable that the use of such designations should be officially restricted. I offer the following suggestions:—(1) Ordinary milk which has not been subjected to heat or been tampered with in any way should be sold as "raw milk." (2) Milk which has been heated should be kept separate from raw milk and should be sold as "pasteurised milk," with a statement of the date and hour of heating, the temperature to which it was exposed, and the duration of such exposure. (3) Milk obtained exclusively from herds guaranteed (not more than six months previously), by official inspection, including the application of the tuberculin test, to be entirely free from disease should be allowed to bear the title of "officially certified milk." In more general terms, my suggestion is that milk which, from the standpoint of medical knowledge, possesses certain important and distinctive features, should be "hall-marked" as such, and that concealment or misrepresentation in regard to these features should be treated as fraudulent. This would be the first step towards affording the purchaser reliable information as to the nature of the article he is buying.

For the purpose of controlling the producer and enlightening the consumer, a regulation requiring all milk to be sold under one of three designations, viz., "raw," "pasteurised," or "officially certified," would be helpful.

(5.) AMERICAN CERTIFIED MILK.

In 1892, Dr. Henry L. Coit initiated a movement for the production of what he termed "certified milk," under the control of "medical milk commissions." From Bulletin 41 of the Washington Hygienic Laboratory, I quote the following outline of Dr. Coit's proposals:—

"First, that physicians give their practical support to an effort conducted by a medical milk commission selected by a medical society, which shall endeavour to bring to the city a supply of milk produced under such regulations that purity shall be assured.

"Second, that approved and trustworthy dairymen possessing honour, financial ability, and dairy facilities shall be induced by reason of promised medical support and the increased price of their milk to conduct their dairies, collect, and handle the product in conformity with the code of requirements made by the aforesaid medical commission and imposed by it in due legal form.

"Third, that the duties of the commission shall be, first, to establish correct clinical standards of purity for cows' milk; second, be responsible for a periodical and personal inspection of the dairy or dairies under its patronage; third, to provide for bi-monthly expert examination of the dairy stock by competent and approved veterinarians and for medical supervision of the employees by competent physicians.

"The milk produced shall also be subject to periodical chemical analysis and to bacterial counts made under the direction of the commission as often as in its judgment is desirable. The experts employed by the commission shall render their reports to this body, which constitute the basis of its certification of the product.

"The expense of examinations and inspections shall be defrayed by the dairymen, but the members of the commission shall receive no pay for their services.

"The findings of the commission shall be published to the profession only, and the milk thus produced shall be known as 'certified milk' and be sold in quart containers bearing the date of milking and the seal of the commission."

This plan has met with success, and twenty-eight milk commissions have already been established on these lines in various parts of the United States. The conditions for the production of milk which the contractors are required to observe are specified in elaborate detail but may be summarised briefly as consisting of perfect hygienic conditions and scrupulous cleanliness. The milk must be promptly cooled after milking, and kept at a temperature not exceeding 50°F. until it reaches the consumer. The bacterial count ought not to exceed 10,000 organisms per c.c.

Certified milk is not expected to compete with ordinary commercial milk. The price is much higher, and the supply is necessarily very limited. The milk is primarily intended for medical purposes where a thoroughly reliable supply is required. For example, in the contract signed with the first producer of certified milk it was stipulated that the milk "shall be designed especially for clinical purposes, and when at any time the demand shall be greater than the supply and is required by a physician, either for infant feeding or the diet of the sick, it is hereby agreed that such shall be the preferred purchaser."

Unfortunately people do not always appreciate the physician's advice. Dr. Westbrook, of Minneapolis, in discussing this question with me, put the case in a nutshell. "They will pay for it as a remedy but not as a prophylactic." Parents willing to incur heavy expenditure for the general welfare of their children do not, except in case of actual illness see the desirability of paying a few cents a day more for milk, when ordinary market milk is, in appearance, "just as good." In fact the slight faecal odour often detected in common milk seems to be attractive. In several cities, producers and other persons interested in the production of certified milk informed me that temporary

customers not infrequently gave them up on the ground that their milk was "tasteless."

In addition to the certified milk bought under medical advice, there is a small but apparently uncertain demand for absolutely pure milk as an ordinary article of diet amongst the better classes in several of the American cities. In Baltimore a firm which has made a very heavy financial outlay and produces milk under ideal conditions informed me that they used to sell 1,200 quart bottles a day of "table milk." Finding that they were losing heavily at the price charged, 15 cents a quart, they raised their terms to 18 cents. In consequence of this change their sales have fallen to 900 quarts a day. From the business point of view it seems to me possible that the certified milk producers would do better if they charged much higher prices, and expended some capital in creating and developing a demand for the milk as a popular fashion. Forty cents a quart, for example, ought to show them a good return. There is nothing impossible about obtaining such a price; it is actually being done. In Philadelphia some of the certified milk is put up in half-pint bottles which are sold at 10 cents each to business men requiring a "rapid lunch." A glass of certified milk for lunch is also popular with New York business men. I mention these details because doubt is frequently raised as to the possibility of producing "certified" milk on terms compatible with financial success. Persons seriously engaged in the sale of other drinks of various kinds usually consider it their first business, whenever introducing a novelty, to find their custom; they do not expect either doctors or the general public to bring it to them. Before deciding that the sale of "certified" milk is not "good business," one must consider whether it has been "pushed" with the intelligence of the average business man.

The production of certified milk has been undertaken in several instances by gentlemen of independent means who have become personally interested in the milk problem and are determined to bring their product up to the standard of perfection, no matter how much it may cost. Their model cowsheds and expensive apparatus are quite beyond the reach of the ordinary farmer who has to earn his living. They have no particular desire to make money out of the business and often run the concern at a loss. Two of these model dairies which I visited were certainly a great pleasure to see, but I attach greater importance to the ordinary, unpretentious and inexpensive dairies of farmers conducting this business on strictly commercial lines. I visited a farmer of the latter type who is producing certified milk for Philadelphia. His place was in excellent order, but the feature he was most proud of was his crop of "alfalfa," which meant a splendid supply of green fodder at low cost. He produces 400 quarts a day of certified milk and obtains $7\frac{1}{2}$ cents a quart for it from the retailer, who sells it at 16 cents a quart. The retailer provides the bottles, which is an expensive item. The selling price of ordinary milk in Philadelphia is eight cents a quart.

The farmer informed me that he was making the business pay, but that his profit was small, and the business was more troublesome than that of the ordinary dairyman, owing to the difficulty of seeing that the farmhands observed the necessary requirements of cleanliness. The equipment necessary to satisfy the demands of the society which certifies him involved an outlay of \$5,000 ; out of this sum \$600 went to the purchase of an autoclave for sterilising his bottles. Everything I saw gave me the impression that this farmer was doing reliable work ; and his reputation, as I learnt afterwards from the secretary of the milk commission, is excellent. Two things, however, seemed to me peculiar : (1) The farmer had a pasteurising apparatus which would take about 80 bottles at a time ; he told me that he pasteurised a small amount of his milk, "because there was a demand for it." This was afterwards corroborated by the secretary, who told me that this milk was specially certified as "pasteurised," and commanded a higher price than the raw certified milk. That there should be any demand for the pasteurisation of milk produced under such stringent conditions is not easy to understand. (2) The farmer did not date his bottles.

I hold the opinion that on a farm producing certified milk no pasteurisation should be allowed, and that the date of bottling should be stamped on the label of every bottle. The particular farmer I saw was not the sort of person likely to resort to dishonest methods, but one must consider this possibility in the case of others. The most important means of controlling certified milk is by means of the bacterial counts, generally made once a week. If, as is not uncommonly the case, the farmer receives official complaints that his counts are exceeding 10,000 and that therefore he must insist on greater cleanliness in milking, it is not at all desirable that the farmer should be tempted to solve the difficulty by pasteurising his milk and bottling it as raw milk. And, with regard to the dating of bottles, though it is not to the interest of the farmer to retain filled bottles on his premises, when bottles are undated there is an obvious temptation for the retailer to add unsold bottles to his next day's supply.

The number of "medial milk commissions" is slowly increasing, but several of the farms are not conducting their business at a profit and would not continue the work if they were not owned by men of independent means who are more interested in the production of thoroughly reliable milk than in making money out of it. In some cases the work has been commenced but has been abandoned owing to the financial loss involved. This loss may have been due partly to lack of public support, but another and more important reason is that unnecessarily large sums have often been expended on buildings and equipment. Clean stables are not necessarily costly stables ; a small amount of labour is sufficient to keep cows clean ; and cleanly milking and handling of the milk until it is sealed in bottles needs vigilant supervision but no large expenditure of money. Failure

due to lavish expenditure of capital in establishing a "show place" is no argument against the possibility of producing certified milk, by reliable methods, with a reasonable margin of profit.

Certified milk never amounts to more than a minute fraction of the total supply of a city; but its production is a valuable object lesson; by showing what milk ought to be, it tends to raise the standard for the general supply. And by teaching the people that the first requirement for the production of sound milk is the possession of a herd entirely free from tuberculosis, it helps, or ought to help, in the movement towards the elimination of bovine tuberculosis. It was suggested to me in Minneapolis that though the production of certified milk might be unprofitable in itself, the enterprise could be made to pay if combined with the business of raising pedigree stock, and I was told at the Health Office that a local farmer who was combining the two pursuits was doing well. The project of combining the trades of certified milk production and the raising of non-tuberculous stock seems worthy of consideration. Both objects, the increase in the supply of thoroughly reliable milk, and the increase in the number of non-tuberculous herds, are difficult of attainment; but they are of such high importance to the community and are so closely connected, that any plausible scheme for working the two together is deserving of a trial.

Two further points may be mentioned. (1) Certified milk is naturally the best material for the preparation of "humanised" milk. But this process involves additional cost, particularly if the milk is put up in small bottles each containing a single feed. Certified milk concerns, particularly those run on philanthropic lines, often take up this latter business. But in considering the financial possibilities of certified milk production, it must not be forgotten that the cost of turning out the milk in quart bottles, or other sizes convenient for general use, must be estimated on a different basis from the cost of turning out humanised milk. The latter is more expensive, and if such milk be sold at a loss it may involve the failure of a firm which might hold its own if limited to the supply of unmodified milk. (2) The poor cannot afford to pay for certified milk at commercial rates. But the production of this article does nothing to increase the price of such milk as the poor are able to buy; and the opportunity is open for municipal or private philanthropic enterprise to provide certified milk for sale to the poor at reduced rates.

The American "Medical Milk Commissions," which aim at the production of thoroughly wholesome milk, are making slow but appreciable progress, and are worthy of imitation.

The possibilities of producing "certified" milk on a financially successful basis have not yet been fully exploited.

Municipal enterprise in the production of certified milk for the purpose of improving the physique, and therefore increasing the wage-earning capacity, of the poorest classes, is also worth considering.

(6.) THE SCORE CARD SYSTEM.

Most of the cities which I visited have adopted the score card system of inspection. When examining a place where milk is produced, handled, or sold, the inspector fills up a card containing a printed list of the details on which he is required to report. For each detail a maximum score of a certain number of points is assigned, the maximum for each detail being proportionate to its importance. The total maximum score amounts to some convenient figure such as 100. Printed instructions on the score card define for each detail the condition for which full marks must be given, and specify the defects for which deductions must be made, and the number of marks to be deducted for each. There is also a space for "remarks" opposite each item, in order that the inspector may explain more precisely his reasons for making any particular deduction. The total number of marks assigned to the place inspected is added up; comparison of this number with the maximum possible score gives a good idea of the general condition of the place. The person in charge of the place is given a copy of the score, and, if he is not satisfied with its fairness, is expected to complain at once to the Health Department. The score cards are filed at the office, and fresh score cards giving the results of reinspections are added to their number.

In all the places where this system is employed, the authorities told me that it is of great utility. Whenever a question arises about any particular farm or milk shop, they at once turn to the score. This gives a convenient numerical expression for the general status of the place and indicates at a glance the nature and degree of particular defects. It helps to make the inspectors do their work thoroughly, because the filling up of a score card necessitates attention to every detail which a complete inspection ought to take into account. It is a guide to the farmer or dealer because it informs him precisely how he stands, and indicates more clearly than verbal descriptions the relative importance of the defects which he ought to remedy. The score cards are also intended to be of service to the consumer; if he wants to satisfy himself about the quality of the milk he is buying, he may call at the health office and inspect the score cards of the concern with which he is dealing. In some of the smaller towns it is the custom to publish periodically a list of all the firms supplying milk, together with the score of each. The town of Montclair, N.J., is a good example of enterprise in this direction. The report of their Board of Health for 1907 contains a list of all the dairymen and dealers supplying milk to the town, and opposite to each name is given the score, under the following headings:—cows (maximum score, 20); stables (25); milk house (20); milking (15); handling of milk (20); total 100. The best firm in the list scored a total of 99 and the lowest obtained 62. Appended to their scores is a series of short comments on all the firms, each of which is mentioned by name. Praise is freely

given, but when the authorities wish to find fault they do not mince matters. "This supply cannot be recommended" is the comment attached to one of the best known and biggest firms in the district. Of two other firms it is said—"the milk is rich but the bacterial count is above the average."

Whilst appreciating the importance of the favourable opinions which various authorities expressed regarding the score card system, I endeavoured to obtain evidence of a statistical nature in support of this view. A particularly interesting instance was brought to my notice by Professor A. C. Lane, of Washington. The town of Richmond, Va., commenced the scoring of dairies at the beginning of May, 1907. The following are the tabulated results of their first year's work.

CLASSIFICATION OF DAIRIES.

Class.	Percentage of all dairies inspected for the month which fell in each class.											
	1907.								1908.			
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.
Scoring below 30	13.8	20.5	3.0	4								
" between 30 and 40 ..	30.8	42.0	21.0	10.7								
" " 40 " 50 ..	26.2	22.4	38.2	29.4	40.0	23.7	14.8	15.8	2.8			
" " 50 " 60 ..	13.8	8.2	22.4	33.3	45.0	35.6	45.0	36.8	11.3	13.6	0.8	5.7
" " 60 " 70 ..			13.2	22.6	12.5	33.0	29.5	23.6	35.2	44.1	39.8	34.3
" " 70 " 80 ..	4.8		1.3		2.5	6.8	8.2	18.4	31.0	25.4	34.2	42.0
" " 80 " 90 ..							1.6	5.4	19.7	16.9	19.2	17.1
Average of all scores for month.	41.5	36.4	47.5	50.6	51.4	5.70	58.4	60.5	70.4	69.6	71.5	72.0

An excellent illustration of the progressive improvement of the fit and elimination of the unfit.

The actual working of the score card system may be considered under three aspects, the efficiency of the inspectors who do the scoring, the influence of the system on the producer, and its influence on the consumer.

The system will not work well if the inspectors are unreliable. In one of the larger cities which I visited, the Health Officer told me that he believed in the score card system in theory, but had not adopted it because he did not think his inspectors were a sufficiently reliable class of men to be trusted to do the work properly. It will be agreed that untrustworthy or inefficient inspectors will not make out reliable score sheets, and it is true that men capable of doing the work properly may not be easy to find; but with inefficient inspectors no system of inspection can be good; the fault lies with the men and not with the system. In some of the cities where the score card is used, I got into conversation with inspectors and endeavoured to form my own opinion as to their reliability. In two instances I thought the men were distinctly careless. Some of the score cards were filled

up in a slovenly manner and contained obvious inaccuracies. One inspector who was showing me a bundle of his score cards happened to mention a particular place, the owner of which had been warned for dirtiness. I asked to see the score card and found that the maximum for cleanliness was 10, but this particular individual's score was a sort of hieroglyphic which might be anything ; the inspector, who wrote it, thought it was probably either seven or one, but could not make up his mind which. I also formed the suspicion that in cases of re-inspection, where the inspector has not got his original score card at hand or where the re-inspection is being made by another man, things get a little mixed up occasionally and require manipulation. Occasionally, I was told, the inspector armed with a score sheet assumed an officious and dictatorial manner which the owner of the premises was apt to resent, and if the owner happened to be a short-tempered country farmer the inspector might meet with some discomfort. In short, I met with little indications every now and again, that some inspectors were not quite all that they should be, and these observations impressed me with the importance of having a vigilant chief inspector who should be capable of keeping his men under proper control and should be allowed to spend a large amount of his time in supervising the accuracy of the score cards by actual visits to the places reported on. But after making due allowance for such indications as I observed that the score card system may be abused and may work imperfectly, I found that the preponderance of evidence was strongly in favour of the system. The method is working well, the authorities are obtaining a more intelligent and reliable class of men for the work, and a better understanding is being established between the inspectors and the trade.

The small country town of Ithaca, N.Y., affords a good example of the score card system at its best. The dairy inspection is in charge of Mr. Ferguson, of Cornell University, who personally inspects about 120 farms. Before filling up a score sheet he makes the farmer fill in answers to a long series of printed questions, covering every detail to be investigated at the subsequent inspection. The farmer is thus compelled to criticise himself, and to make acquaintance with his own shortcomings, before receiving any adverse criticism from the inspector. And as the farmer knows that he will be required to verify his statements, he has good reason to examine his dairy equipment with a critical eye. This makes the inspector's duty of fault finding much easier. Questions of fact being more readily agreed to, the score card can be filled up without causing resentment ; the inspector then proceeds to offer friendly suggestions of remedies and improvements, and is soon able to convince the farmer that the object of his visit is to help rather than to interfere. The work of education has to be done gradually. When the inspector finds a tumble-down cowshed with a low roof laden with dirt and cobwebs, a leaking wooden drain, bad light, no system of ventilation, a ramshackle outhouse

for cooling and bottling, and defective cleansing apparatus, he does not talk about model cowsheds and ideal dairy equipments, but points out obvious improvements which can be made readily and without any expenditure which is beyond the farmer's means. At each subsequent visit he praises such improvements as have been made and suggests something further.

Mr. Ferguson took me on a tour of inspection to several farms in the neighbourhood of Ithaca. One of them was a model dairy owned by a man who aimed at perfection regardless of expense. He complained that his score card had been marked too liberally. The other places were small farms, each with about a dozen cows, owned by men of very limited means. The cowsheds were badly constructed and the milk rooms were too small to allow of the work being done properly; but from the various improvements which had been made and were pointed out to me it could be seen that the farmers were doing their best. The influence of the scoring system was shown by the eagerness of the farmers to learn how they could obtain more marks. The competitive element appealed to them; the addition of a few more marks here and there by more attention to details would enable them to equal or excel a neighbour whose score at present stood above theirs. The scores are published periodically in the local paper, are keenly discussed, and stimulate the rivalry of the farmers. The prospect of scoring more marks will induce a farmer to keep his cows clean, clip the hair about the udder, and attend to other details, far more effectively than discussions of bacterial content or the general requirements of a pure milk supply. The special feature of the system is that it stimulates improvement by voluntary enterprise and without resort to coercion. When the inspector knows his business and gains the confidence of the farmer he rarely has to resort to the threat that the licence will be withdrawn unless improvements are effected. The farmer endeavours to reform because a bigger score means an increase of his reputation amongst his neighbours and a possible expansion of his custom.

The influence of the score card on the consumer is difficult to estimate. A definition of the quality of a milk supply based on an objective statement, such as the score card provides, ought to be appreciated, but the average consumer is often influenced by some purely capricious reason in the choice of his milkman. The main fact which is emphasised by American experience is that the score cards have more influence on the farmer when he knows that their contents are accessible to the consumer. This element of publicity is recognised as important even in cases where scoring by marks is not resorted to. When in Boston I was informed by the officials of the State Board of Health that the score card system had not been adopted by Massachusetts, but the dairies were officially divided into two categories—(1) "commendable" and (2) "those having objectionable conditions." This classification is based on official inspection by a trained veterinarian specially appointed for the purpose. Every month

the Official Monthly Bulletin of the State publishes a statement of the number of dairies examined during the month and the number found "commendable." The names and localities of all the "commendable" dairies are given, but, acting on the advice of their Attorney General, the State does not publish the names of the "objectionable" places. In the case of these latter the Secretary of the State Board of Health sends a letter to the farmer, calling attention to the defects revealed by inspection and concluding with the sentence—"If, on second inspection, the same condition of affairs is found to obtain, it will be necessary to take steps leading to the exclusion of your milk from public sale." The health authority in the town receiving the milk is also notified, and when the milk is being sold to a large contractor he is advised of the unwholesome conditions, and generally, I was told, finds it to his advantage to exclude such milk from his supply. During the period from July, 1905, to April, 1908, the State Inspector examined 8,340 dairies and found 2,655 of these "commendable." To what extent the consumer exhibits a preference for milk coming from "commendable" dairies I was not able to ascertain.

In several places where the score card system exists and seems to be working well, I suggested that the system might be made still more effective by requiring the milk dealer to exhibit along with his permit, which he is compelled to post up in his shop or on his wagon, a copy of the latest scores relating to his milk. My suggestion was not cordially received, though I was unable to discover any insuperable objection to it; it appears to me that if the right of the public to know the contents of a score card be recognised, as it is in many places, the most effective plan would be to make the dealer exhibit his score to his customers. There is, of course, the possibility that if this plan were adopted, careless work on the part of an inspector would come to light in a rather inconvenient fashion, and the health authorities might consequently get into difficulties; the temptation for an inspector to accept bribes might also be increased.

Given competent, honest, and tactful inspectors, the score card system works well and is advantageous alike to the health authority, the producer, and the consumer. Its most important service is that it provides a steadily applied stimulus to voluntary improvement, where the conditions fall far short of the ideal but do not lend themselves to correction by coercive measures.

(7.) FROM COW TO CONSUMER.

In all the places which I visited I endeavoured to ascertain from the authorities how far they were able to trace milk back from the consumer to its source. One of the conditions on which the milk sellers hold their license is that they must keep the authorities informed of the place or places from which they obtain the milk. If the milk seller obtains all his supply from one farm, the task of tracing it back is easy; the difficulty arises

from the bigger concerns who receive their milk from a large number of sources. In Philadelphia, I was told, the dealers who send out a large number of milk wagons keep a record of the source supplying each wagon and generally supply each wagon from the same one or two dairies. But the answer which my enquiries usually elicited was to the effect that the identity of the milk was lost when it arrived at the city contractor, and that the only thing to do when dealing with a case of infectious disease possibly due to milk was to take up the contractor's list of farms supplying him and investigate all of them. In the case of big contractors selling unpasteurised milk, I expressed the opinion that this must be a very formidable task. Whilst not disputing my view, the authorities generally pointed out that they took elaborate precautions to secure early notification of infectious disease arising on any of the farms supplying the contractors; it was better to prevent infective bacteria, *e.g.*, typhoid bacilli, from getting into the milk at the source than to wait for them to reach the consumer, where there would be the long delay of the incubation period before they manifested their presence. This line of argument did not satisfy me, because I was aware of the importance of early notification of disease in dairies and regarded this as a question distinct from the problem of tracing milk from the consumer back to the herd. For this latter problem, it appears to me, the American authorities have not been able to provide a satisfactory solution. In fact the difficulty arising from the trade custom of mixing milk appears to be as great in America as in England, possibly greater. In a country district I visited a small farmer who bottled and sold milk; his total output was only 100 quarts a day but this was a mixture from five different sources, his own cows and the cows belonging to four farmers in the neighbourhood. In the larger businesses, where the milk before commencing its transit by rail is mixed at a country creamery or collecting station supplied by various farms, the difficulty of tracing back from consumer to cow is obviously much greater.

In America, as in England, one meets with the trade objection that mixing is necessary in order to average the qualities of milk obtained from various sources. Whatever may be the importance of this requirement, to the trade, it is certainly not greater than the importance, to the general public, of enabling the health officer to trace back to its source milk which is suspected of conveying infectious disease. It is no excuse to say, as has been said to me in America, that the mixing of milk dilutes the infective material and thus reduces the dangers which might arise from it. On the contrary, the mixture of milk containing pathogenic bacteria with wholesome milk makes the whole of the mixture infective. When the swine of Minnesota were fed with a mixture of wholesome skim milk and skim milk containing living tubercle bacilli, they became infected with tuberculosis; the dilution of the pathogenic material with innocuous material did not prevent them from acquiring the disease. The disease

continued to spread, and, being associated with financial loss, necessitated the passing of a law prohibiting the feeding of swine with factory skim milk containing any living tubercle bacilli, no matter how few in number. And with regard to pathogenic bacteria in general, it must not be forgotten that milk is an excellent nutrient medium, and that therefore the number of such bacteria present when the milk reaches the consumer may be much greater than the number immediately after mixing.

In order to meet the difficulty arising from this trade custom, I suggest that action might be taken in accordance with the following principles. When a case of infectious disease arises where the milk is suspected and where it is known that the milk has not been pasteurised, the ultimate source of the supply ought to be immediately inspected. If the dealer can satisfy the medical officer that the milk in question is derived entirely from one farm, the expense of inspecting that farm ought to be borne by the public authorities. If there are several possible sources, the expense of inspecting all except one ought to be borne by the dealer. The matter might be simplified and made easier for the dealer by putting a limit on the amount of mixing. Assuming that the dealer receives milk of three qualities, *viz.*, (1) average, (2) above average, (3) below average, he might send out (1) unaltered, and limit his mixing to (2) and (3), by adding a particular lot of (2) to a particular lot of (3) and labelling the mixture with the names of the two sources. Before I sailed for America Dr. Manby took me to Paddington Station and showed me the mixing process as it is conducted on the platform. The contractor's foreman grades the milk by some rapid empirical method best known to himself. What one actually sees is that he opens several churns, removes a gallon or more from each, and fills up the partially emptied churns with milk different from that which they originally contained. Here it seems reasonable and very desirable that the law should step in and insist that after the mixing is over the churns should be re-labelled. If they originally contained milk, respectively, from farmers A, B, and C, they should be re-labelled, *e.g.*, mixture of A + B, B + C, or, if requisite, A + B + C. As the business is at present conducted, it is impossible to trace milk back to the herd; the expenditure of a few minutes in re-labelling the churns would at least remove one obstacle which now stands in the way.

The American cans used for the transit of milk are smaller than the English churn. They differ in size in different districts. In Minnesota, I was told, cans of 5, 10, and 15 gallons capacity are used. I do not remember seeing any cans so large as 15 gallons in any of the States through which I travelled; 10 gallons and 5 gallons, or thereabouts, are the sizes usually found. Some of the 5-gallon cans which I saw in Baltimore were placed within an outer can, the space between the two being packed with ice. In New York City the cans which I saw arriving by train were of 10 gallons capacity; lumps of ice were placed

between the cans and generally rested on the shoulders of adjacent cans.

The particular size of the cans does not seem to be a matter of much importance, but it is an obvious advantage to have a uniform size for all cans travelling by a particular route. It is also an advantage to have all the cans completely filled. If however a very large size such as the English 17-gallon churn is used, it may frequently happen that one of the cans sent from an individual farm is only partially filled; hence the custom of filling up such cans with milk obtained from another source, with its attendant evils of promiscuous mixing, unsealed cans, and the impossibility of tracing milk back to the farm. But as the avoidance of these evils is of greater importance than the observance of absolute uniformity in the size of cans, the simplest way out of the difficulty would be to make the farmer use a can of smaller size, *e.g.*, 5 or 10 gallons, for the milk left over after he has filled all his churns. The additional inconvenience caused by the haulage of a few of these smaller cans would be trifling as compared with the advantage of preserving the identity of all the milk arriving by rail.

All the American cans I saw were covered with a closely fitting metal lid (the Boston wooden plug seems to be going out of fashion). The upper surface of the lid was generally convex, with the rim slightly projecting beyond the mouth of the can. None of the lids were perforated. In only a few instances did I find the cans sealed.

Whilst feeling that the Americans might with advantage attach more importance to the sealing of cans, I freely admit that they are greatly in advance of the old country in the matter of protecting milk from contamination by dirt during transit. At the first half-dozen places I visited, I volunteered the information that many English dealers thought that the presence of holes in the lid of a milk churn was necessary in order to make the milk "keep." My statement was always received with an outburst of laughter, and I was usually told that it was just the funniest thing ever heard. It is quite common in America for the milk dealer to consider that "aeration" of milk in the milk room is necessary in order to get rid of the "cow smell," but the idea that milk should be exposed to the contamination of the dirt which accumulates during railroad transit is regarded in America, and very properly, as simply disgusting. Feeling somewhat ashamed of my countrymen, I abandoned this subject, after the first fortnight. All I can say by way of rejoinder is that in one of the largest cities in the Eastern States I elucidated from an inspector a remarkable suggestion. We were going round on night work, and it was part of his duty to ascertain that the empty milk cans sent to the station for return to the farmer had been properly cleansed. I tipped up several lids, and, as it was too dark to see, relied on the sense of smell. The odour of putrid milk was unmistakable, close proximity being both unnecessary and undesirable. The inspector admitted that

there was "a slight stuffy odour," but explained that this was usual in empty cans and that a ventilation hole ought to be perforated in the lid, "in order to let out the smell." It is only fair to add that his suggestion has not been officially adopted.

Bottled milk is sold in much larger quantities in America than in England. When the empty bottles are, after washing, sterilised in an autoclave, when the bottling apparatus is bacteriologically clean, and when the filled bottles are dated, bottled milk is decidedly better than the same milk sold "loose." But these precautions are very far from being universal; in fact, the observation of all three of them is the exception rather than the rule. Without these precautions, bottled milk is an article of doubtful reliability. Amongst the lower classes empty milk bottles are frequently used for disgusting purposes; and even the better class of consumer frequently returns the bottles in a state which makes them very difficult to cleanse properly with the aid of a brush, alkaline solution and hot water. These difficulties, and the imperfect way in which they are often met, were impressed on me by a farmer's wife, who was responsible for the bottle-cleansing part of the business. Failing to recognise my friend as an inspector, and mistaking us both for "gentlemen at large," she talked freely on the subject. Her revelations were somewhat disquieting. No bottle seems as yet to have been invented which is both satisfactory and cheap enough to be discarded after once being used. Paper bottles, saturated with paraffin, have been tried, but I have not found any instance of their successful adoption. In one place I was told that the fatal objection was that the customer would not buy them because the cream layer could not be seen; the American housewife seems to attach more importance to the presence of a deep cream layer on the top of the milk bottle than to the date of bottling. In another place the objection was that some of the paper bottles leaked; and in a third I was told that the disposal of the waste paper, if the bottles came into general use, would become a serious nuisance.

Whilst the various difficulties which I have mentioned differ in importance, the conclusion seems to be warranted that the bottling of milk requires careful supervision and demands official attention.

The fact that, in the American trade, milk is handled in dust-proof receptacles demonstrates the absurdity of the notion that ventilation holes are necessary.

On arrival at its destination by rail, milk should be in sealed cans bearing the name of the farm where it was produced.

Promiscuous mixing of milk intended for sale without pasteurisation is undesirable. If some mixing be necessary for the purpose of averaging the quality of milk sold as raw milk, the dealer should be saddled with the responsibility of labelling the mixture with the names of the two or more sources from which it was obtained.

When milk is sold in bottles, official supervision is desirable, to ensure the bacteriological cleanliness of the bottles and bottling apparatus.

PART III.

Summary.

Throughout the above Report I have called attention to certain salient points by the use of italics. The following is a summary of the statements thus emphasised.

1. It is, so far as my observations enable me to speak, useless to attempt the formulation of any general plan for the complete eradication of bovine tuberculosis throughout this country within a limited period.

2. It is imperative, in the interests of agriculture, that dairy cows with advanced or generalised tuberculosis, or with tuberculosis of the udder, should be destroyed.

3. The public must be prepared to meet all the cost of adequately inspecting the condition of dairy cattle.

4. It is essential, in the interests of agriculture, that compensation should not be paid out of the public funds for slaughtered cattle showing advanced or generalised tuberculosis, or tuberculosis of the udder.

5. The testing of entire herds, with tuberculin should be encouraged, and for this purpose the assistance of public money is requisite and desirable.

6. Public money spent on re-testing, with a view to establishing thoroughly the soundness of herds giving on the first test either no reactions or only a small percentage of reactions, would be money well spent.

7. Reacting animals possessing a market value might under special circumstances be taken over by the community at a price exceeding their market value; but with this limited exception, compensation out of the public funds does not appear to be justifiable.

8. Local authorities by establishing and maintaining clean herds for the supply of public institutions, would provide a valuable means of educating the farmer.

9. The difficulty at present seems to lie not so much in the lack of public support, of a financial nature, as in the lack of evidence that the agricultural interest is prepared to turn to good advantage such effective public support as might be offered.

10. It is true in fact that in America the local sanitary authority enforces regulations for the control of the milk supply by the exercise of its own unaided powers, and that the exercise of such powers is sanctioned both by law and by public opinion.

11. Aggressive programmes of milk reform have not succeeded in America and are not to be recommended.

12. Actual reforms are mainly due to the acceptance of reasonable recommendations offered by the medical officer, and are attributable to the recognition rather than to the exercise of this officer's right of direct intervention.

13. The theoretical right of the medical officer to withhold or revoke a permit for any and every breach of the municipal regulations may be questionable.

14. In practice the permit system works well and involves no hardship or injustice to the honest dealer.

15. The direct control exercised by the permit system is an effective instrument of reform; prosecutions in the law courts are not.

16. The exclusion from a city of milk which is not provided with a reasonable guarantee that it has been produced under wholesome conditions is justifiable.

17. It would be an advantage to entrust to the local health authorities reasonable and legally defined powers of direct control over the production and sale of milk.

18. Commercial pasteurisation is firmly established and cannot be abolished; but it seems both possible and desirable to institute a system of inspection which shall provide a guarantee that the work is done efficiently, with regard to the interests of the consumer and in accordance with the standard of skill, care, and cleanliness already observed by the better class of firms.

19. Whilst official encouragement or enforcement of pasteurisation might be objectionable, it would appear useful and reasonable to insist that pasteurised milk shall be sold as such, in order to enable the consumer to choose for himself between the pasteurised and the raw article.

20. Routine bacteriological examinations of samples, for the guidance of the milk inspection service, are valuable and should be adopted. They afford the most reliable, the cheapest, and often the quickest means of discovering when milk has been improperly handled.

21. Upon the pathogenic effects of many of the bacteria commonly present in milk further research is needed.

22. At present it seems impossible to compel English milk-sellers to keep milk at a temperature not exceeding 50° F. in hot weather.

23. For the purpose of controlling the producer and enlightening the consumer, a regulation requiring all milk to be sold under one of three designations, *viz.*, "raw," "pasteurised," or "officially certified," would be helpful.

24. The American "medical milk commissions," which aim at the production of thoroughly wholesome milk, are making slow but appreciable progress, and are worthy of imitation.

25. The possibilities of producing "certified" milk on a financially successful basis have not yet been fully exploited.

26. Municipal enterprise in the production of "certified" milk for the purpose of improving the physique, and therefore increasing the wage-earning capacity, of the poorest classes is also worth considering.

27. Given competent, honest, and tactful inspectors, the score card system works well and is advantageous alike to the health authority, the producer, and the consumer. Its most important

service is that it provides a steadily applied stimulus to voluntary improvement, where the conditions fall far short of the ideal but do not lend themselves to correction by coercive measures.

28. The fact that, in the American trade, milk is hauled in dust-proof receptacles demonstrates the absurdity of the notion that ventilation holes are necessary.

29. On arrival at its destination by rail, milk should be in sealed cans bearing the name of the farm where it was produced.

30. Promiscuous mixing of milk intended for sale without pasteurisation is undesirable. If some mixing be necessary for the purpose of averaging the quality of milk, sold as raw milk, the dealer should be saddled with the responsibility of labelling the mixture with the names of the two or more sources from which it was obtained.

31. When milk is sold in bottles, official supervision is desirable, to ensure the bacteriological cleanliness of the bottles and bottling apparatus.

ARTHUR EASTWOOD.



